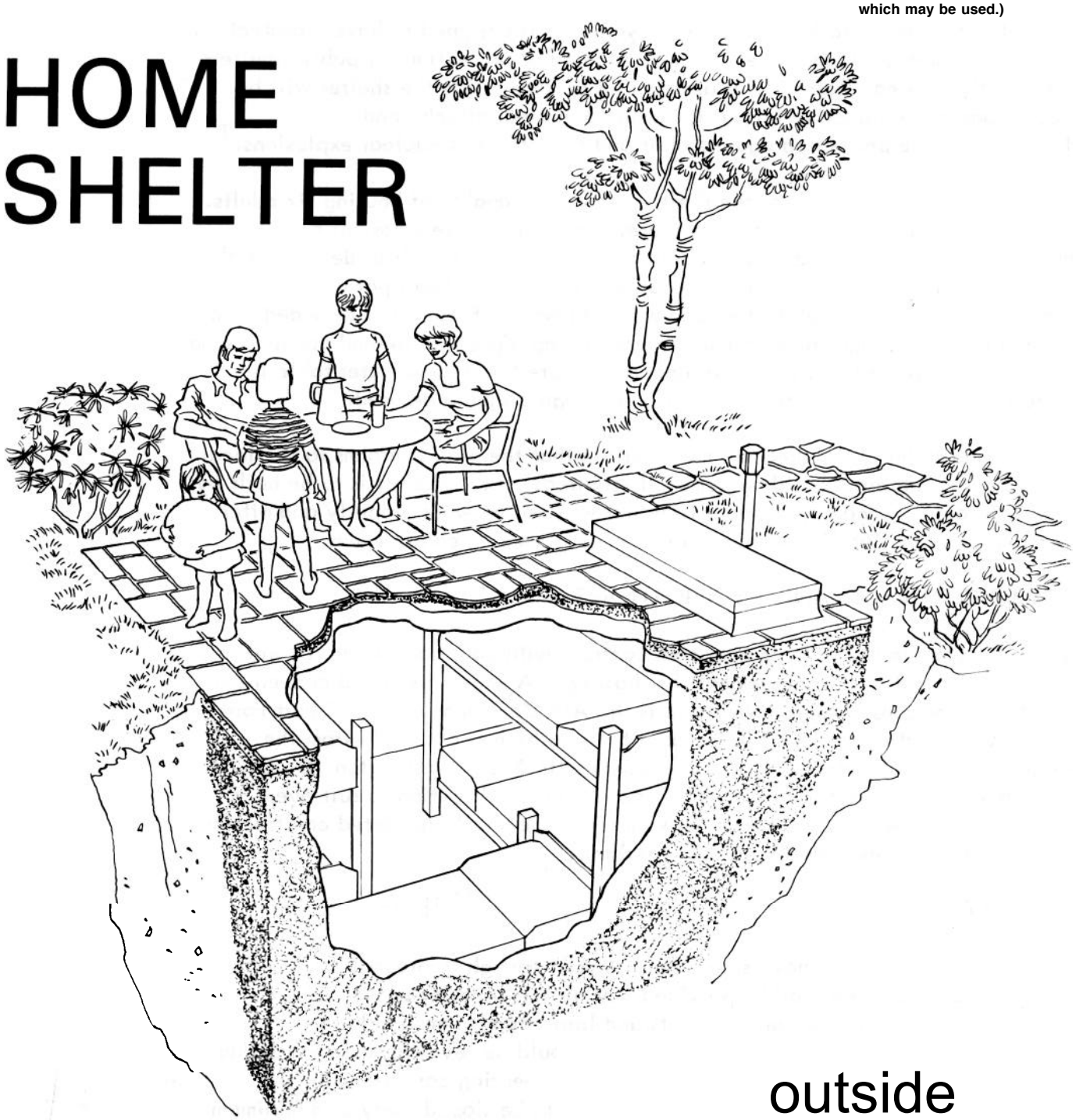
H-I 2-1
JUNE 1980
(Supersedes H-12-1
dated April 1975
which may be used.)

HOME SHELTER



Protection is provided in an outside concrete shelter. The roof of the shelter can be used as an attractive patio.

outside concrete shelter

federal emergency management agency

GENERAL INFORMATION

This family fallout shelter, designed primarily for homes without basements, is a permanent home shelter to be placed in the yard. It is designed to have a protection factor of at least 40, which is the minimum standard of protection for public shelters throughout the United States. This assures that persons inside the shelter will be protected against radioactive fallout following a nuclear attack, and will also have some protection against blast and fire effect of nuclear explosions.[1]

Following are detail drawings of the shelter, which is capable of housing six adults. It can be built of poured reinforced concrete, precast concrete slabs, or a combination of concrete blocks and poured concrete. If it is built as detailed with the top near ground level, the roof slab can be used as an outdoor patio. The shelter is accessible by a hatch-door and wood stairway. Fresh air is provided by a hand-operated centrifugal blower and two ventilating pipes that extend above ground level. In areas where there is poor drainage or where the ground water table is close to the surface, the fourth modification on page 5 should be used.

Before starting to build the shelter, make certain that the plan conforms to the local building code. Obtain a building permit if required. If the shelter is to be built by a local contractor, engage a reliable firm that will do the work properly and offer protection from any liability or other claims arising from its construction.

GUIDE TO CONTRACTS AND SPECIFICATIONS

It is generally advisable to have a written contract with your contractor, as well as technical specifications to supplement the drawing. A widely used and convenient contract form for construction of this size is the AIA Document A 107, "Short Form For Small Construction Contract -Stipulated Sum, " which is available from the American Institute of Architects, 1785 Massachusetts Ave., Washington, D. C. 20036. It would be impractical to write a technical specification to suit every local condition; however, the following summary of generally accepted construction materials and practices should be a useful guide.

EXCAVATION

The excavation should have side slopes gradual enough to prevent caving, or appropriate shoring should be provided. Materials used for backfill and embankment should have debris, roots and large stones removed before placement. The subgrade for the floor slab should be level for ease in placing waterproofing membrane and to provide uniform bearing conditions for the structure. The area surrounding the patio should be sloped away at a minimum grade of 1 inch per 10 feet to provide good drainage.

[1] This shelter will withstand overpressures of up to 5psi, and provides excellent protection from tornadoes.

CONCRETE

For details of concrete construction, the "Building Code Requirements for Reinforced Concrete/ (ACI 318 – 71)" should be followed. This publication can be obtained from the American Concrete Institute, Detroit, Michigan 48219.

WATERPROOFING

Waterproofing specifications may be obtained from the nearest FHA (Federal Housing Administration) office, or those of a reputable manufacturer of waterproofing materials may be used.

VENTILATION

The ventilation piping for the shelter should be installed in accordance with the practices outlined in the "National Plumbing Code (ASA A40.8 – Latest Edition). " This publication may be secured from the American Society of Mechanical Engineers, New York, N.Y. 10018. All pipe and fittings shall be galvanized. Suitable ventilating blowers and roof ventilators are available from many sources of supply. Fabrication details and consequently the installation requirements will differ for equipment furnished by the various manufacturers. Positive-displacement blowers having both electric motor and geared hand-crank drives have been manufactured by:

Centaur Forge, Ltd.
P. 0. Box 239
117 N. Spring St.
Burlington, Wisconsin 53105

B&B Sales
P. 0. Box 86
So. Decatur Street
Marietta, Pa 17547

TEMET USA, Inc.
9417 Brian Jac Lane
Great Falls, VA 22066

Roof exhaust and supply ventilators are manufactured by:

Penn Ventilator Co.
Red Lion and Gantry Rd.
Philadelphia, PA 19115

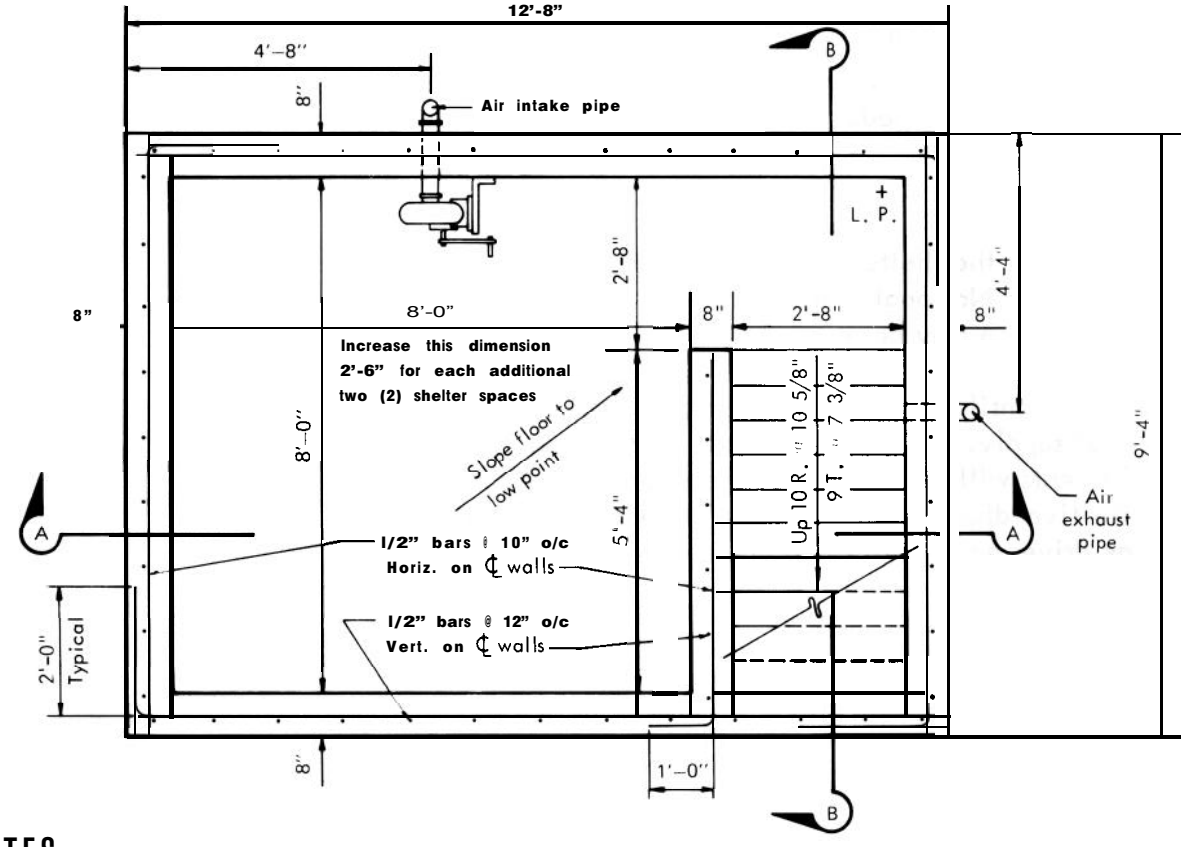
The names of specific manufacturers of equipment are given only as examples, and do not denote a preference for their products.

OPTIONS

To accommodate additional persons, increase the shelter length 2'-6" for each two (2) shelter spaces. Do not increase the 9'-4" width.

Electrical serv ice for lighting and outlets may be installed in the shelter from a separate residence circuit. A branch circuit breaker should be installed inside the shelter. Additional lighting and outlets may be provided from this circuit'for the patio above.

An electric motor and pully may be installed to operate the centrifugal hand-crank blower by virtue of the electrical service option.



NOTES

Exterior walls, roof slab and under floor slab shall be waterproofed with a 3-ply membrane waterproofing system. This provides a continuous blanket which seals the entire area of surface to be protected. The membrane shall be protected from backfill damage and when completing other stages of construction.

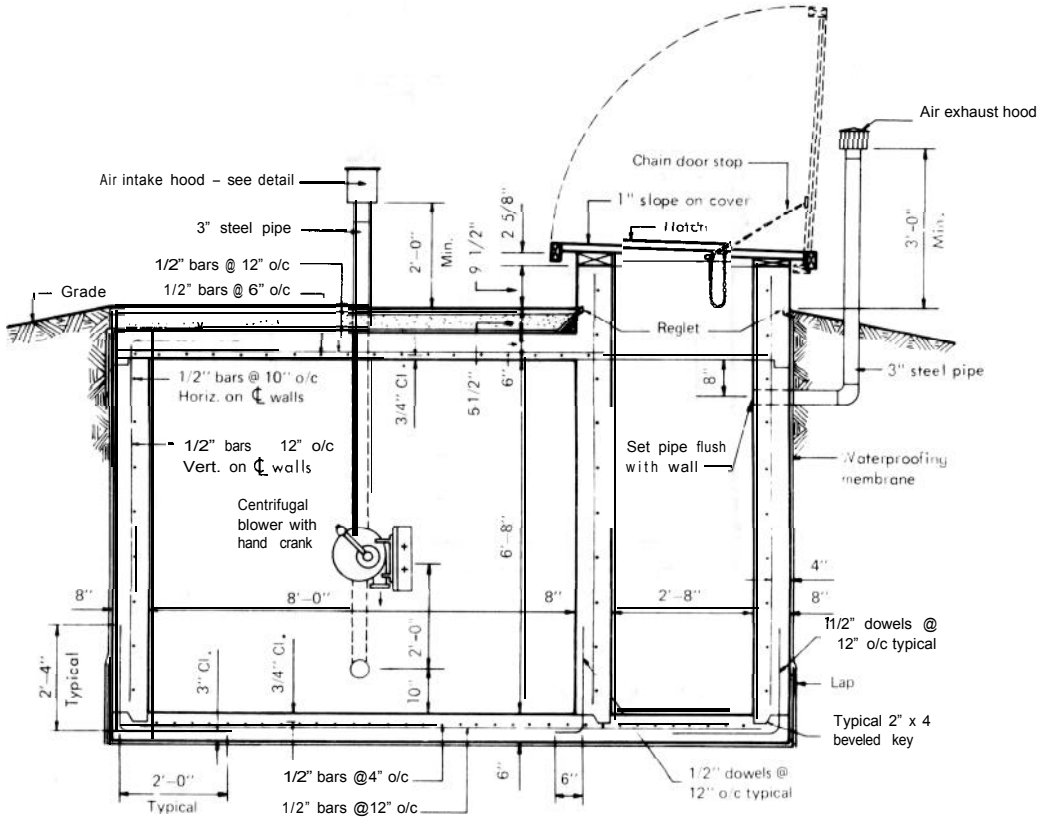
Place flagstone or bricks on a sand bed when using the roof slab as a patio.

There are a number of commercially produced metal roof hatches that will adequately serve as a shelter door. However, as long as the door is weatherproof and durable, a job-made, galvanized sheet metal covered wood door is suitable.

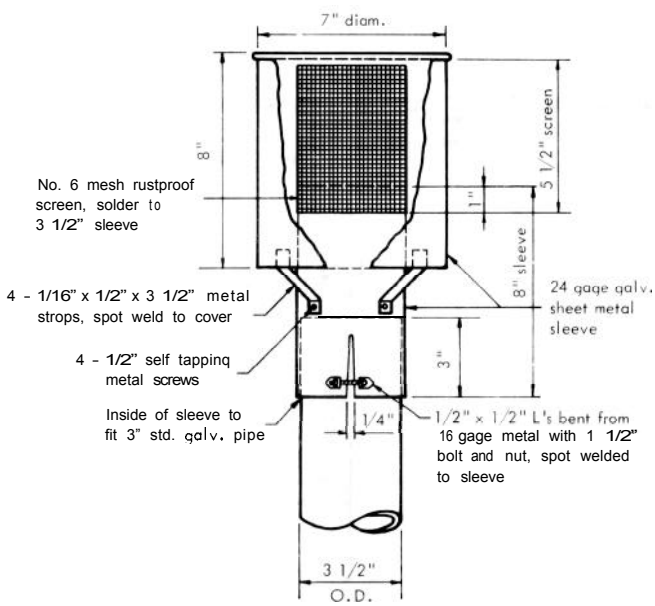
Bevel all exposed corners of concrete 3/4" at 45^{o}.

Structural design data:

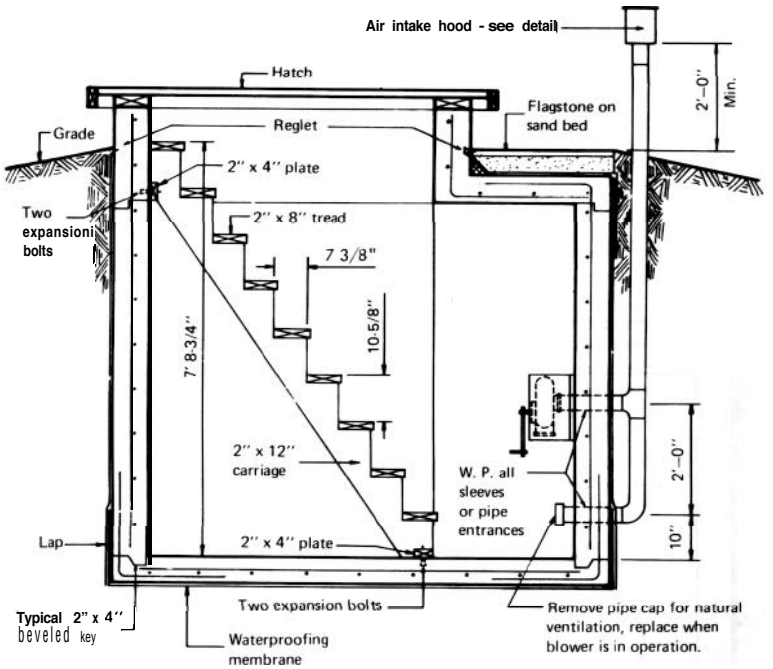
Steel = 20,000 psi
Concrete = 2,500 psi
Soil (minimum) = 600 psf, to withstand downward pressure



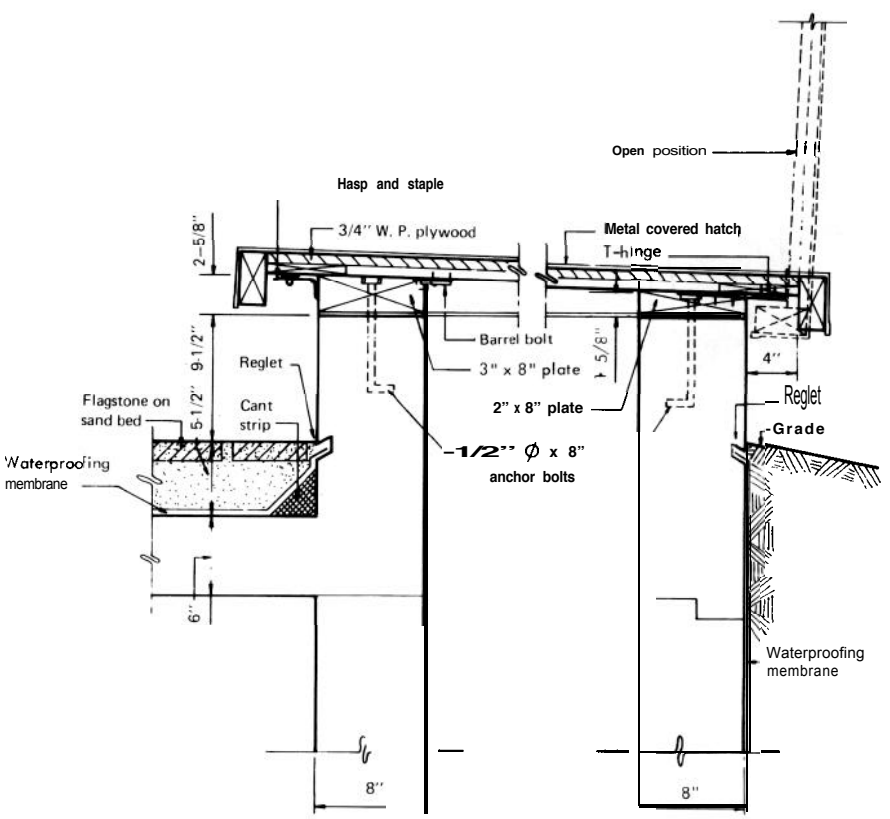
SECTION A- A



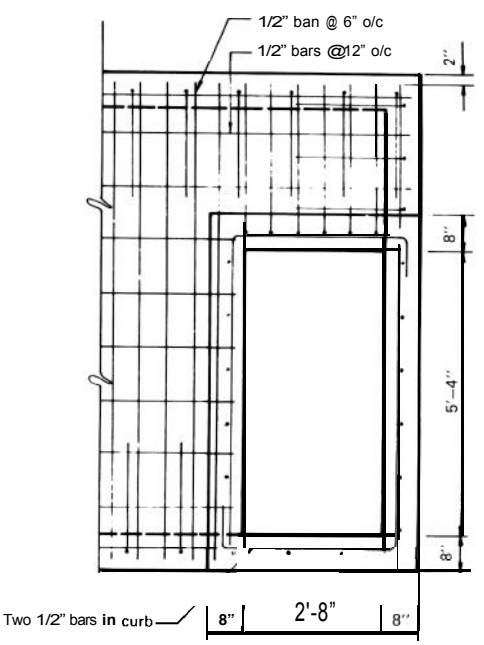
AIR INTAKE HOOD DETAIL



SECTION B-B

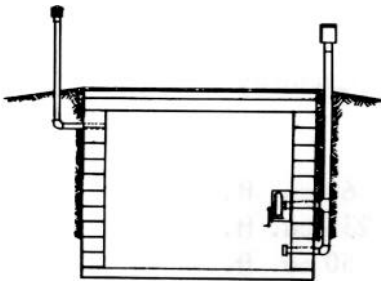


HATCH DETAIL



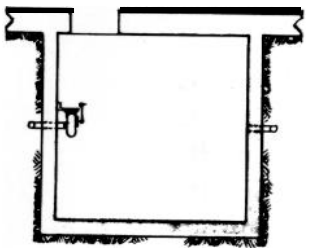
HATCH FRAMING

MODIFICATIONS



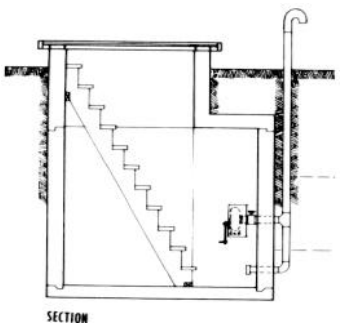
SECTION

This first modification utilizes 12-inch concrete masonry units for walls instead of reinforced concrete. The floor, roof and entranceway are the same as in the basic shelter, and the amount of protection provided is essentially the same.



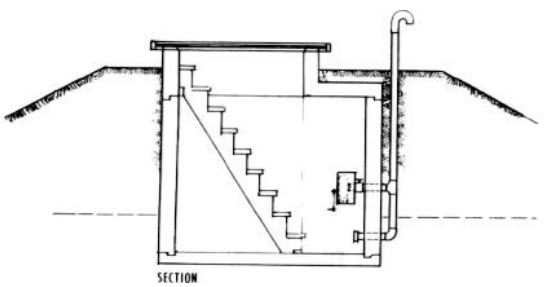
PLAN

If a basement is available, the shelter may either be separate from it, or attached. In this modification, an attached shelter is entered through the basement of the house, thereby permitting dual use of the shelter space. Other advantages of this modification include flexibility of shape and design to conform to the house design and the use of the same kind of building materials as used in the construction of the house.



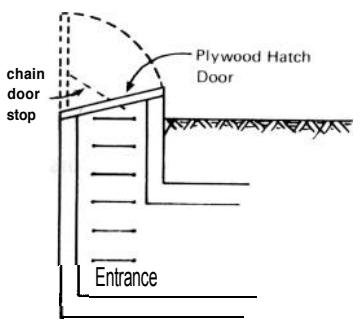
SECTION

If the topography permits, the shelter can be built into a hillside or embankment. This modification increases the protection factor by the addition of an earth mound over the shelter. A maximum of 3 feet of earth cover is recommended.



SECTION

The principal advantage of this shelter modification is that it can be erected with a minimum of excavation in locations where there is poor drainage or where the ground water table is close to the surface. However, the exposure of the shelter above ground requires the addition of earth mounding around all sides.



This shelter modification permits the design and construction of a shelter with a fairly small hatch entry. The iron rungs placed in the concrete wall will also maximize the useable shelter area.

MATERIAL LIST

Item	Quantity
Concrete:*	
floor	60 cu. ft.
walls	235 cu. ft.
roof	50 cu. ft.
	345 cu. ft.
Total	13 cu. yds.
Steel Reinforcing:	
floor	580 lin. ft.
walls	945 lin. ft.
roof	260 lin. ft.
Total	1,785 lin. ft.
Miscellaneous:	
tie wire - 6" coils	2
hand blower w/mounting bracket	1
3" galv. steel pipe	16 lin. ft.
3" galv. ells	2
3" galv. tee	1
3" galv. cap	1
intake hood, w/screen	1
exhaust hood, w/screen	1
wood carriages, 2" x 12" x 10'	2
wood treads, 2" x 8" x 2'-8"	9
wood plates, 2" x 4" x 2'-8"	2
hatch door, metal covered	1
wood plate, 2" x 8" x 7'	1
wood plate, 3" x 8" x 14'	1
T-hinges, 8" x E. H., galv.	3
hasp and staple, galv.	1
chain door stop, galv.	1
anchor bolts, 1/2"ϕ x 8"	8
expansion shields and bolts, 3/8" ϕ x 4"	4
waterproofing membrane	715 sq. ft.
flagstone	100 sq. ft.
sand	1.5 cu. yds.
cant strip	12 lin. ft.

*Form work not included.

Distribution:
FEMA Regions and Staff College
State & Local Civil Preparedness Directors

U.S. GOVERNMENT PRINTING OFFICE : 1980 0 329-359

ABOVEGROUND HOME SHELTER

H-I 2-2
JUNE 1980
(Supersedes H-12-2
dated Feb. 1973
which may be used.)

Protection is provided in an outside aboveground shelter. The shelter can be used as a tool shed or workshop.

federal emergency management agency

GENERAL INFORMATION

This family shelter is intended for persons who prefer an aboveground shelter or, for some reason such as a high water table, cannot have a belowground shelter. In general, belowground shelter is superior and more economical than an aboveground shelter.

The shelter is designed to meet the standard of protection against fallout radiation that has been established by the Federal Emergency Management Agency for public fallout shelters. It can also be constructed to provide significant protection from the effects of hurricanes, tornadoes, and earthquakes, and limited protection from the blast and fire effects of a nuclear explosion. 1/ It has sufficient space to shelter six adults.

The shelter can be built of two rows of concrete blocks, one 12" and one 8", filled with sand or grout, or of poured reinforced concrete. Windows have been omitted; therefore, electric lights are recommended for day to day use.

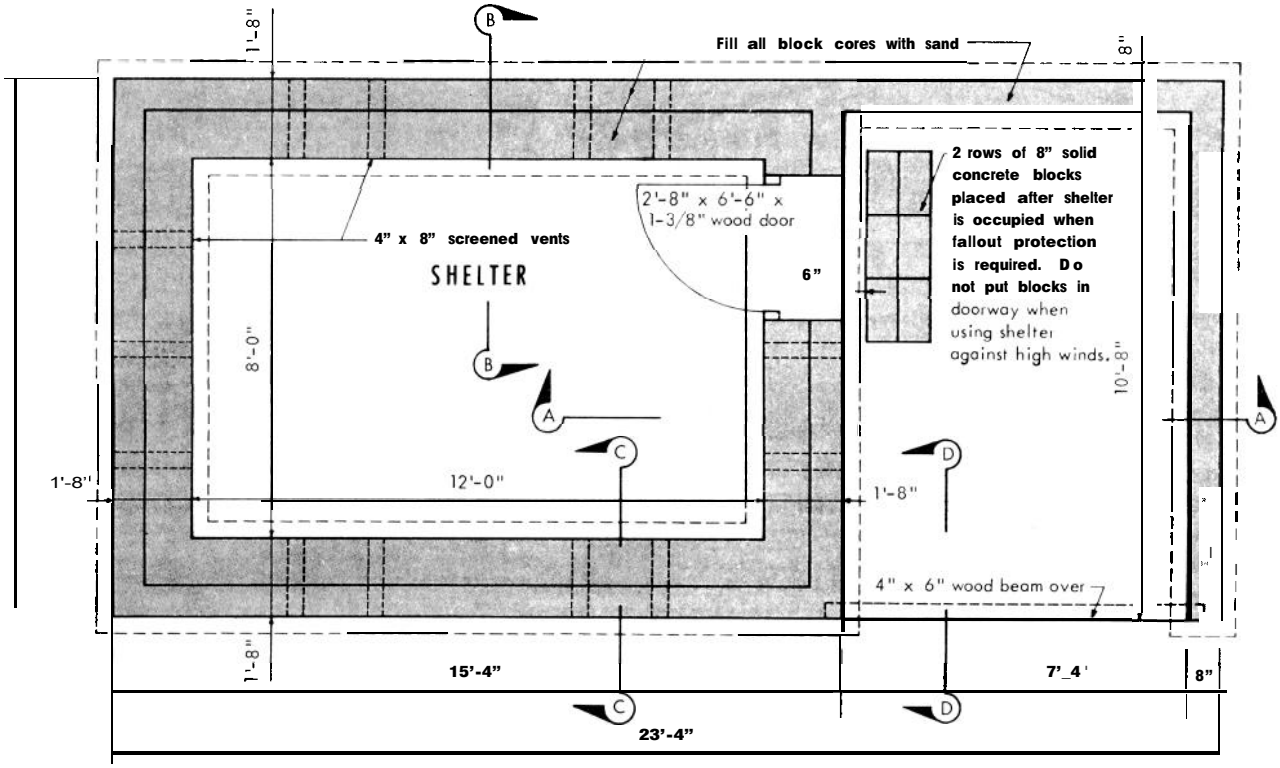
The details and construction methods are considered typical. If materials other than shown are selected -- for example, concrete block faced with brick -- care should be taken to provide at least the same weight of materials per square foot: 200 lb. per sq. ft. in the walls and 100 lb. per sq. ft. in the roof. The wood frame roof over the reinforced concrete ceiling probably would be blown off by extremely high winds such as caused by a blast wave or tornado. However, the wood frame roof is intended primarily for appearance; the concrete ceiling provides the protection. When using the shelter for protection against high winds, DO NOT place the concrete blocks in the doorway or windows.

This structure has been designed for areas where frost does not penetrate the ground more than 20 inches. If 20 inches is not a sufficient depth for footings, one or two additional courses of concrete blocks may be used to lower the footings. Average soil bearing pressure is 1,500 lb. per sq. ft. Most soils can be assumed to support this pressure without special testing or investigation.

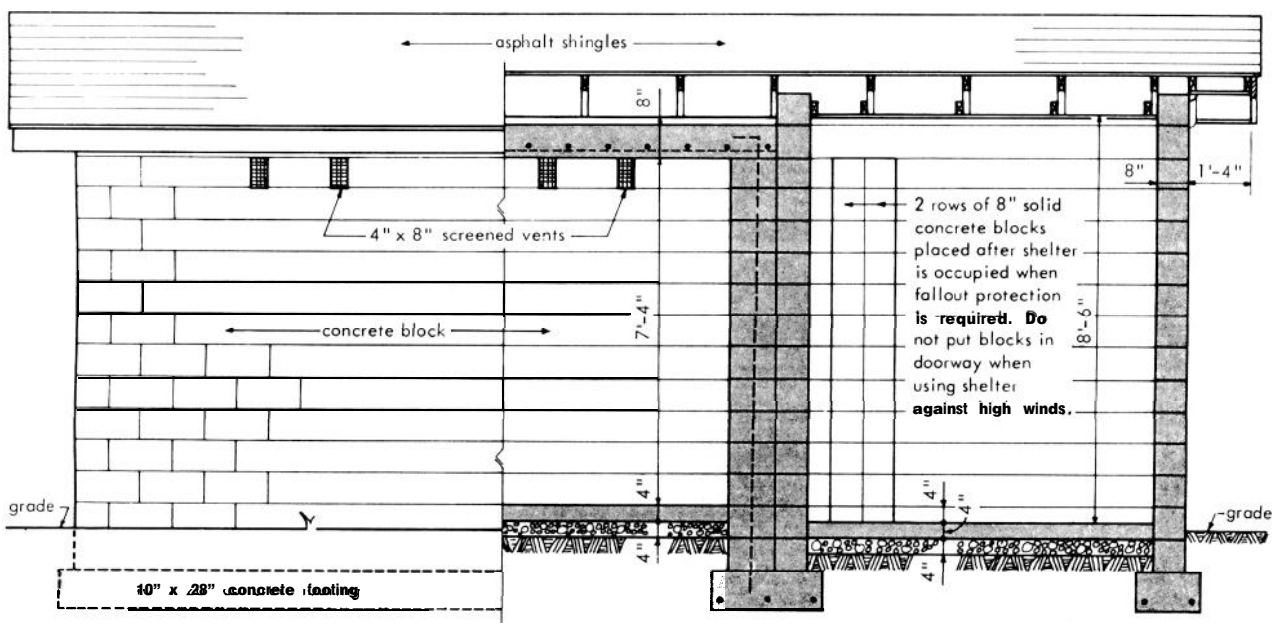
The baffle wall outside the entrance to the shelter is extended out 7'-4" to allow storage of lawn equipment such as wheelbarrows and lawn mowers. If additional space is desired, extend this dimension.

Before starting to build the shelter, make certain that the plan conforms to the local building code. Obtain a building permit if required. If the shelter is to be built by a contractor, engage a reliable firm that offers protection from any liability or other claims arising from its construction.

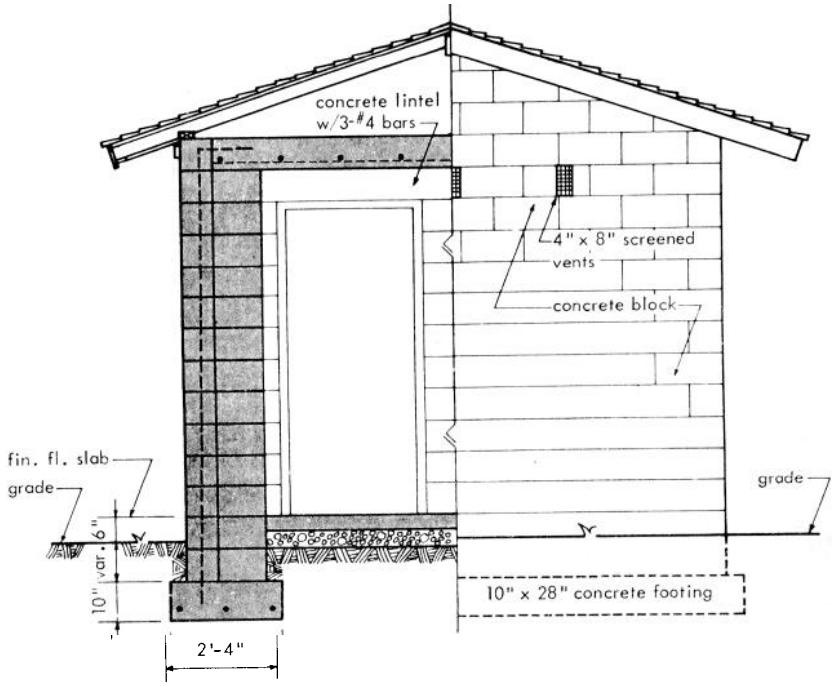
1/ This shelter will withstand over-pressures of up to 5 p.s.i.



PLAN



ELEVATION SECTION A-A



SECTION B-B ELEVATION

NOTES

Provide horizontal joint reinforcement for 1'-8" walls in every third course and metal cross ties at 2'-0" o.c. in every alternate course.

If concrete is used in place of block, the walls of the shelter shall be 1'-2" thick with #4 bars at 14" o.c., each way, each side.

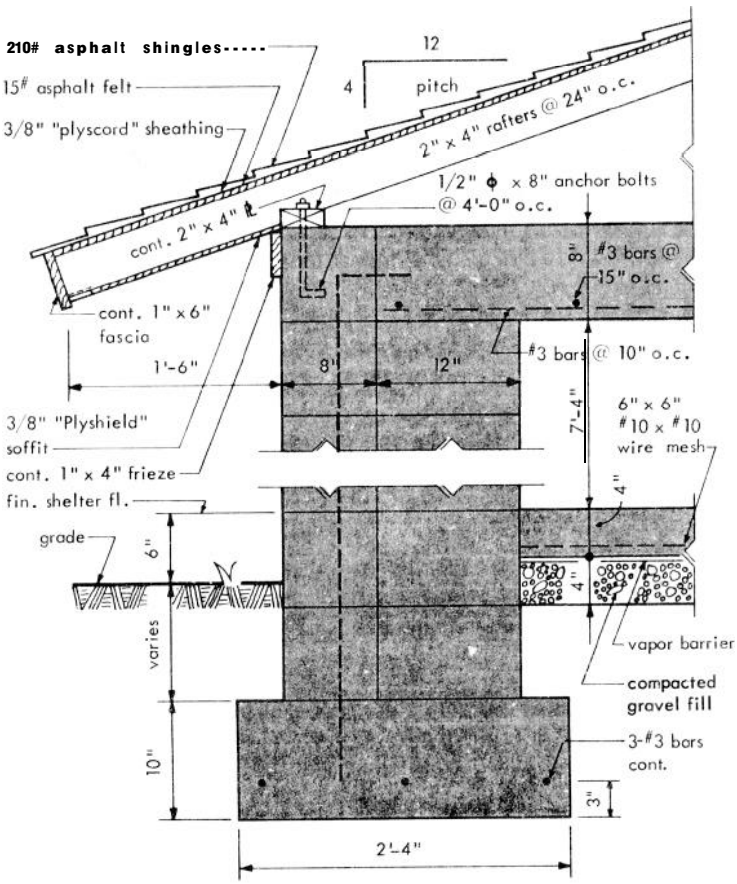
The dimension from finish grade to bottom of footings is dependent upon the depth of frost and varies with geographic location. Consult your local building code.

In areas subject to hurricanes, tornadoes, or earthquakes, walls shall be reinforced with #4 bars at 16" o.c. vertically. Place bars in block cells and then fill with grout. Lop bars between wall and footing dowels, and between wall and roof slab.

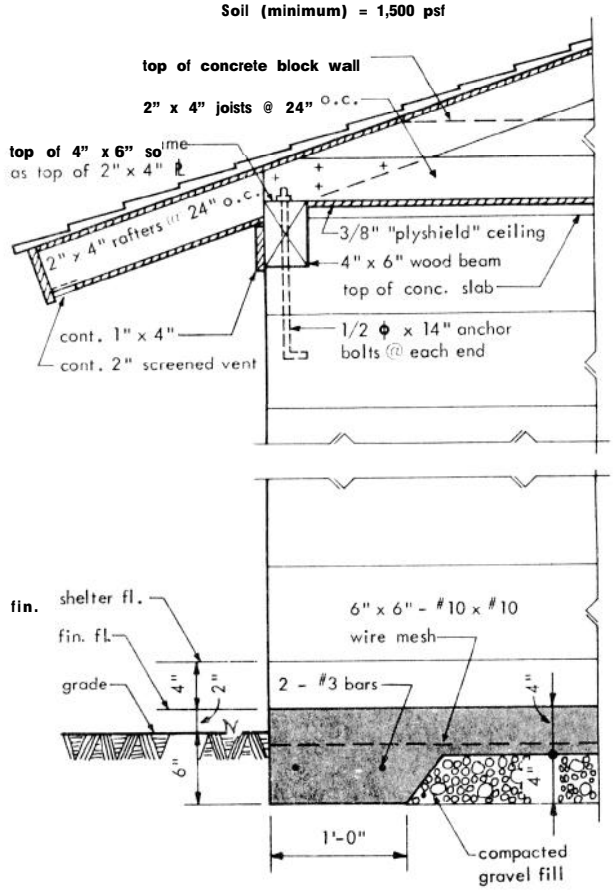
The wood frame roof over the reinforced concrete ceiling probably would be blown off by extremely high winds such as caused by a blast wove or tornado. However, this roof is primarily intended for appearance; The concrete ceiling provides the protection.

Structural design data:

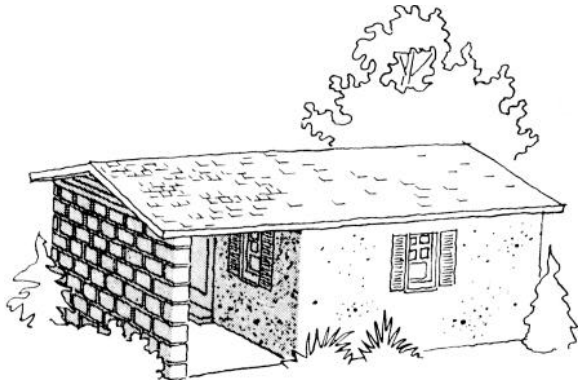
Steel = 20,000 psi
Concrete = 2,500 psi
Soil (minimum) = 1,500 psf



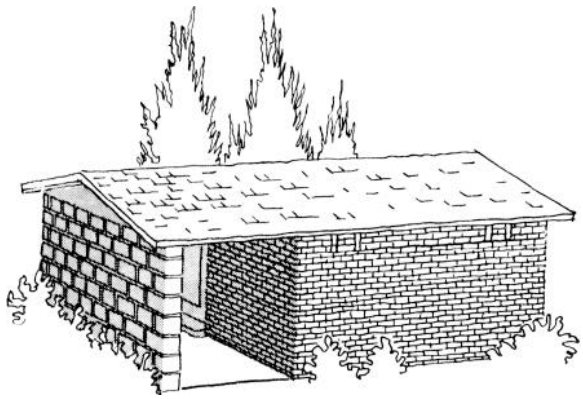
SECTION C-C



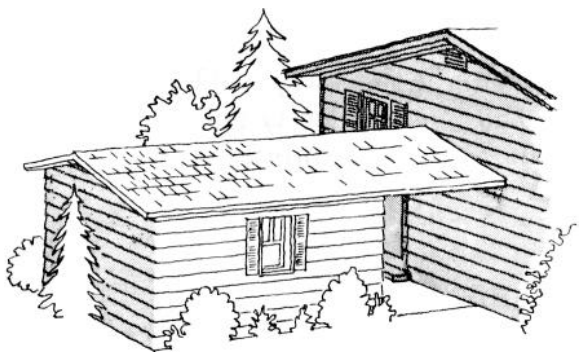
SECTION D-D



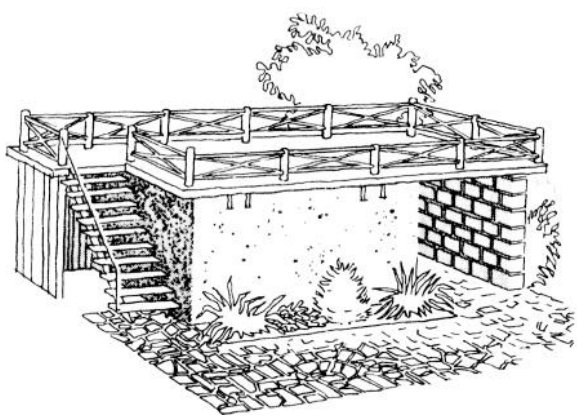
FIRST ALTERNATE indicates windows in the workshop area. Solid blocks, equal to a thickness of 12 inches, should be available to fill these openings to provide adequate fallout protection. Window sizes should be kept small. When using the shelter for protection against high winds, do not place the concrete blocks in the doorway or windows.



SECOND ALTERNATE shows the cement block faced with bricks. Use one course 4-inch brick and two courses of 8-inch cement block to obtain the required weight per unit area.



THIRD ALTERNATE is to attach the tool shed or workshop to the house, with a covered area between. In this case, the facing materials should match the house.



FOURTH ALTERNATE is to install built-up roofing of asphalt or tar, or other wearing surface, on top of the concrete deck.

GUIDE TO CONTRACTS AND SPECIFICATIONS

It is generally advisable to have a written contract with your contractor as well as specifications to supplement the drawing. A widely used and convenient contract form for construction of this size is AIA Document A 107, "Short Form For Small Construction Contract Stipulated Sum," which is available from the American Institute of Architects, 1785 Mass. Ave., Washington, D.C. 20036. It would be impractical to write a specification to suit every local condition; however, the following summary of generally accepted construction materials and practices is a useful guide:

CONCRETE

For details of concrete construction, follow "Building Code Requirements for Reinforced Concrete (AC I-3 18-71)." This publication can be obtained from the American Concrete Institute, Detroit, Michigan 48219.

DAMPPROOFING

Dampprcofing the bottom slab is necessary to make the room more comfortable in most areas. Any contractor will be accustomed to compacting gravel and applying a polyethylene vapor barrier course. In areas that regularly experience high humidity, the outside walls of the block or concrete should be treated with a colorless type of protective coating material which is readily available at building supply stores. In areas of very low humidity, dampproofing might be omitted.

VENTILATION

Ventilation is obtained by natural convection. Air will enter the doorway and be exhausted through the holes at the ceiling. If a roof exhaust ventilation system is desired, the following manufacturer makes units that will meet the requirements:

Penn Ventilator Co.*/
Red Lion and Gantry Rd.
Philadelphia, Pennsylvania 19115

*/The listing of a specific manufacturer of equipment does not denote a preference for his products.

OPTIONS

To accommodate additional persons, increase the shelter length 2' -6" for each two shelter spaces. Do not increase the 8' -0" width.

Lighting and receptacles may be installed with electric service obtained from a separate residence circuit. A branch circuit breaker should be installed inside the shelter.

MATERIALS LIST

Item		Quantity
Concrete:		
footings		4.5 cu. yd.
floor		2.3 cu. yd.
ceiling		3.4 cu. yd.
	Total:	10.2 cu. yd.
Steel Reinforcing:		
footings (3# deformed bars)		198 lin. ft.
ceiling (3# deformed bars)		257 lin. ft.
walls (4# deformed bars for hurricane, tornado, or earthquake resistance)		
	approx.	300 lin. ft.
	Total:	755 lin. ft.
tie wire		100 lin. ft.
Masonry:		
8" X 8" X 16" hollow concrete blocks		800
12" X 8" X 16" hollow concrete blocks		430
8" X 8" X 16" solid concrete blocks		75
sand (to fill cores)		12-1/2 yd.
Mortar:		
sand		1-1/2 yd.
portland cement		9 bags
lime		2 bags
Lumber: ("construction"grade)		
2" X 4" X 8'-0" roof rafters		32 pcs.
1" X 6" ridge		26 lin. ft.
2" X 4" X 12'-0" ceiling joists		5 pcs.
4" X 6" X 8'-0" beam		1 pc.
2" X 4" bearing plate		36 lin. ft.
4'-0" X 8'-0" X 3/8" "plyscord" sheathing		13 sheets
4'-0" X 8'-0" X 3/8" "plyshield" soffit & ceiling		6 sheets
1" x 4" x 3/4"		48 lin. ft.
1" X 6" X 3/4"		84 lin. ft.
3/4" - 1/4¢		24 lin. ft.
2'-8" X 6'-6" X 1 3/8" solid core wood door		1
2'-8" X 6'-6" X 5 1/2" wood jamb		1

Miscellaneous:

15# roofing felt	4 1/2 squares
210# asphalt shingles	4 1/2 squares
1/2" ϕ X 8" anchor bolts	12
1/2" ϕ X 14" anchor bolts	2
copper screen	20 sq. ft.
6" X 6" - #10 X #10 wire mesh	200 sq. ft.
polyethylene vapor barrier (4 mil)	200 sq. ft.
gravel fill	2 1/2 yds.
4" butts w/screws	3
lockset	1
16d common nails	25 lb.
8d common nails	20 lb.
6d common nails	10 lb.
8d casing nails	5 lb.
exterior paint, primer	5 gal.
exterior paint, 2 coats	6 gal.
interior paint, primer	4 gal.
interior paint, 2 coats	5 gal.

Distribution:

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U.S. GOVERNMENT PRINTING OFFICE : 1980 0 - 329-360

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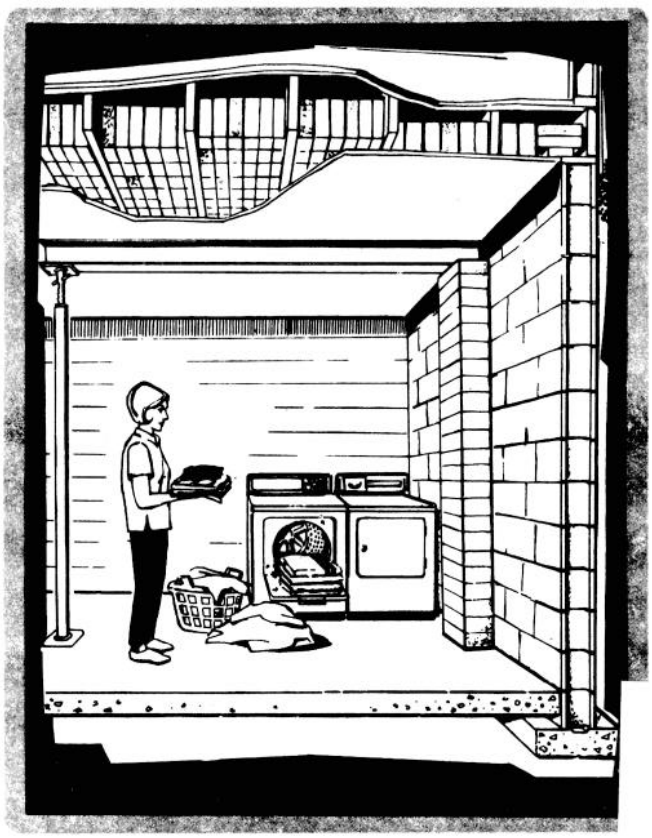
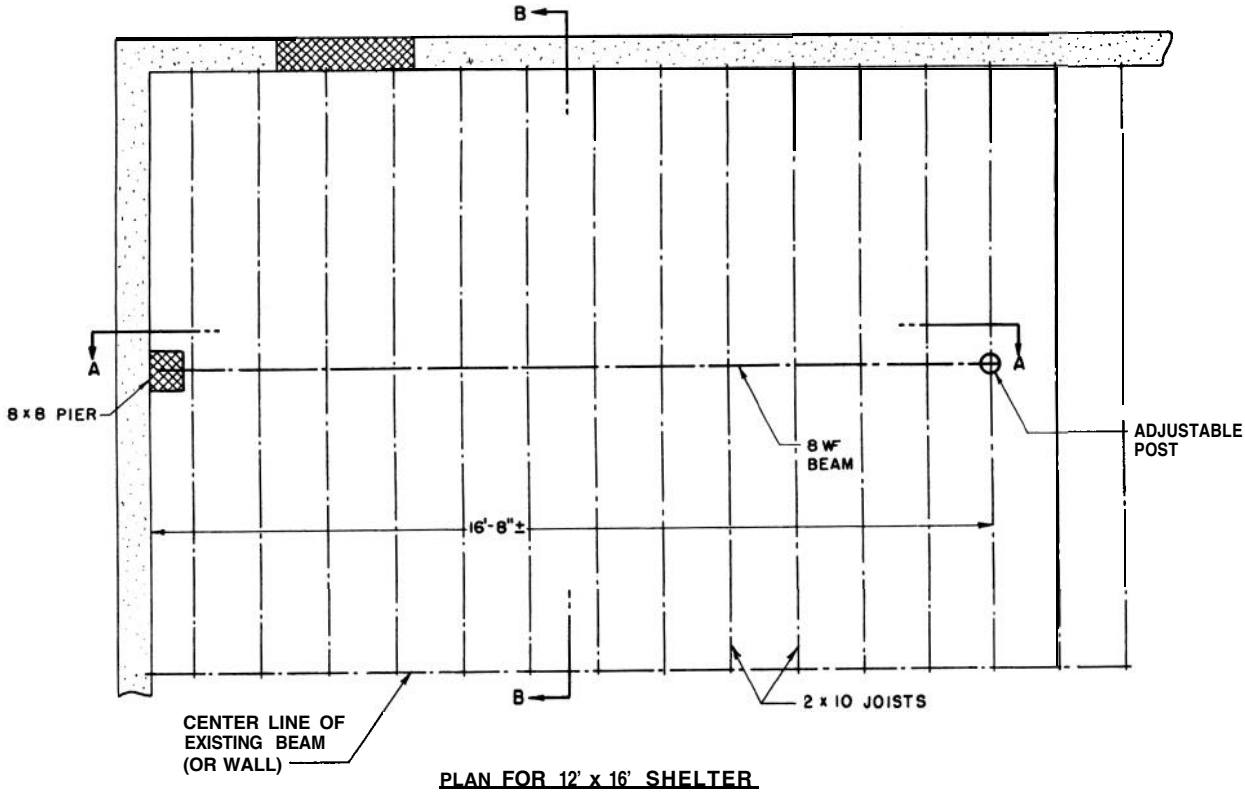
H-12-A
April, 1980



Protection is provided
in a basement corner
by bricks
or concrete blocks
between the overhead joists.
A beam
and jack column
support the extra weight.

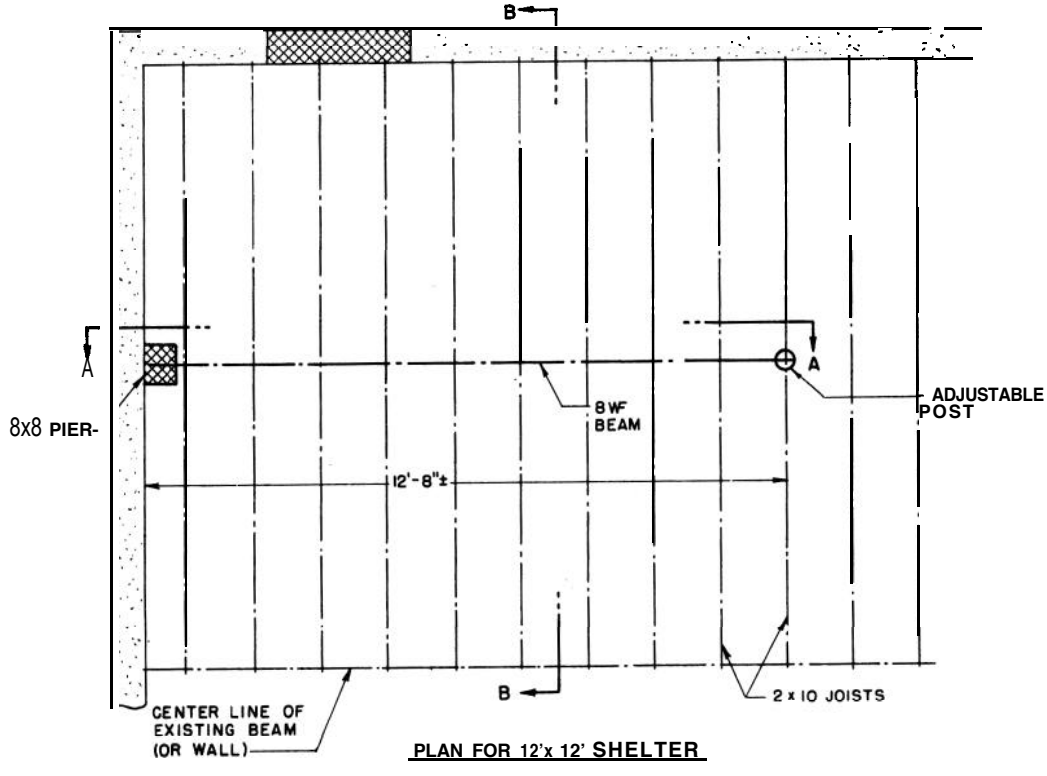
HOME FALLOUT SHELTER
modified ceiling shelter-basement location plan a

FEDERAL EMERGENCY
MANAGEMENT AGENCY

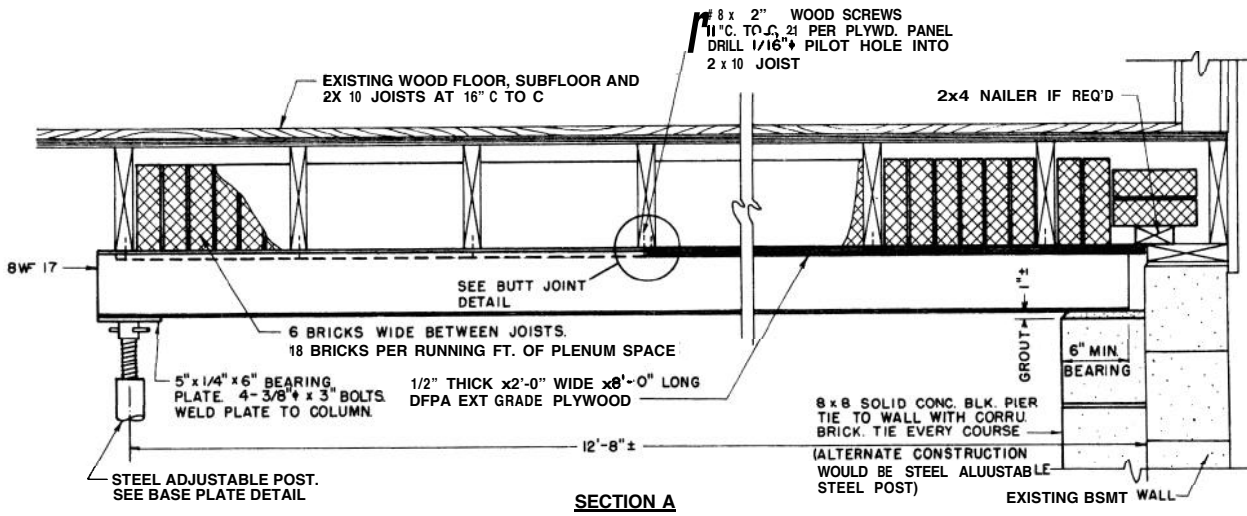


PLAN FOR 12' x 16' SHELTER

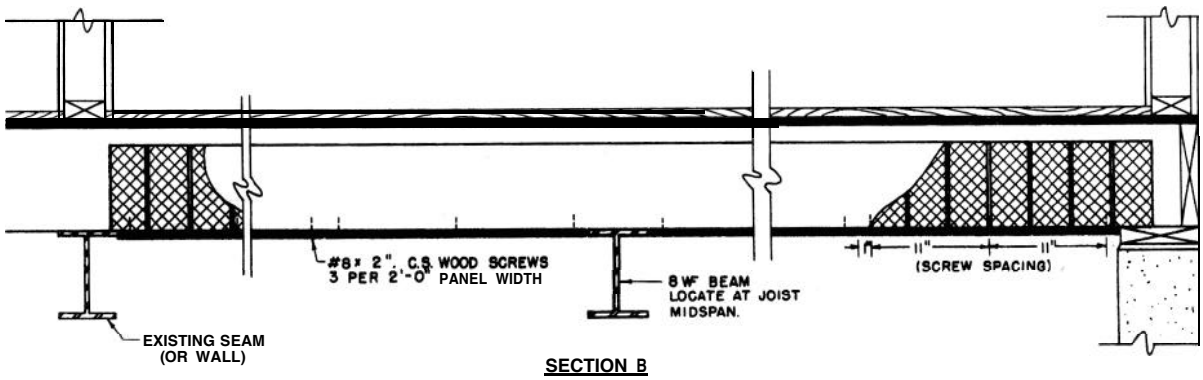
BLOCK UP ANY WINDOWS IN SHELTER AREA



PLAN FOR 12'x 12' SHELTER



SECTION A



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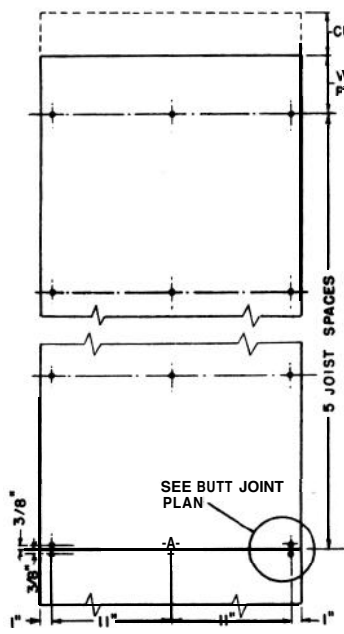
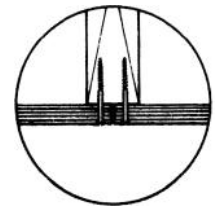
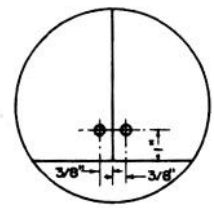


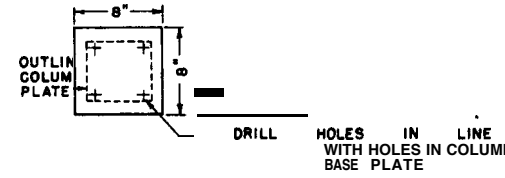
PLAN OF TYPICAL PLYWOOD CEILING PANEL



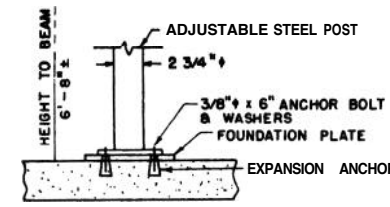
BUTT JOINT DETAIL



BUTT JOINT PLAN.



FOUNDATION PLATE PLAN



BASE PLATE DETAIL

CAUTION

This home fallout shelter design should only be constructed in low risk areas. A low risk area is one which is not expected to be subjected to the blast effects of a nuclear weapon. It is suggested you contact your State or local civil preparedness director for information concerning the type of area you live in, i.e., low risk or high risk area.

GENERAL INFORMATION

This shelter can be permanently installed in the basement of your home and will not interfere with its utility in any way.

In basements whose walls are mostly below grade on all four sides, adequate shelter from fallout radiation is provided by modifying the overhead floor joist and ceiling construction as shown in the drawings. The plywood, which is screwed to the bottoms of the joists, supports the masonry shielding material and provides a solid base for a more decorative ceiling treatment. A beam and jack post are used to support the extra weight. Approximately 2 man days are required to construct the ceiling.

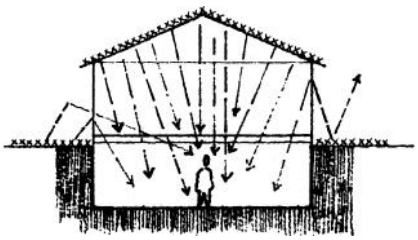
SHELTER SIZE

The plans on the preceding pages show two sizes of shelters of this type - **a 12' x 16'** size, which may be suitable for use in many one story homes, and a **12' x 12'** size, which is suitable for use in many two story homes.

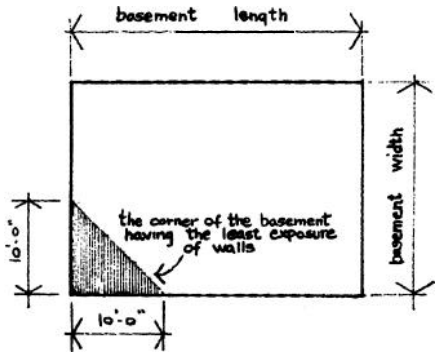
On the following pages, under LIMITATIONS OF THE CEILING MODIFICATION SHELTER IN BASEMENTS, you will find illustrations of the conditions which make this type of construction an effective shelter, and some additional things that must be done if these conditions are not met by your particular basement situation.

Note that if some joist spaces contain heating ducts, or are closed in with sheet metal to serve as return air ducts, the protection in this area of the shelter is reduced since bricks or blocks cannot be placed as shown in the drawings.

LIMITATIONS OF THE CEILING MODIFICATION SHELTER IN BASEMENTS

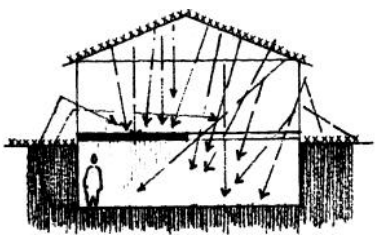


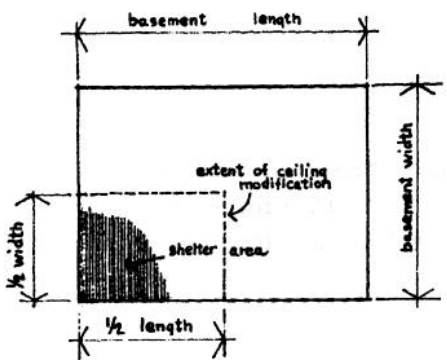
This cross-section of a one story house shows radiation coming into the basement from fallout particles on the roof and the ground, Most of the radiation comes from the roof because of the shielding effect of the ground outside the basement walls.



The shaded area in the basement floor plan shows the location of the best potential shelter area (approximately 50 square feet). The drawings on the preceding pages are for the adding of bricks or blocks in the ceiling over this best corner.

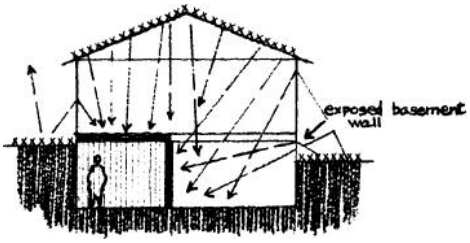
This placement of added weight in the proper portion of the basement ceiling will considerably improve the protection in the best corner. Note that is not necessary to add this weight to the entire ceiling area.

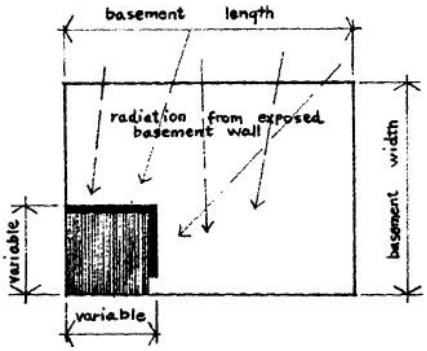




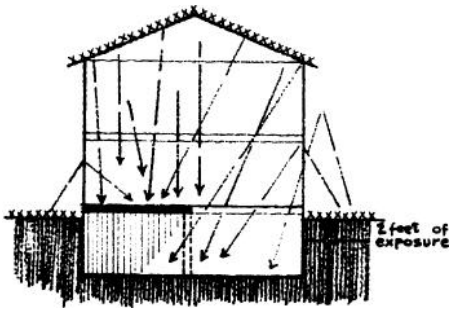
The extent of the ceiling modification area depends on the type of house (i. e., one or two story), the dimensions of the basement, and the amount of basement wall exposure. In a one story house, approximately one - quarter of the area of the basement ceiling should be filled with the concrete blocks or bricks in order to obtain the most protection out of this improvement.

This arrangement will effectively shield all of the radiation coming from the roof - the largest contributing source.





If it is found to be impractical to shield one quarter of the basement ceiling area, the extent of ceiling modification may be reduced to any desired size by constructing vertical masonry walls on the two open sides of the shielded area, thus providing a room suitable for use as a hobby or laundry room. These masonry walls will also provide protection from excessive amounts of radiation coming through exposed portions of the basement wall.



In homes with 2 or more stories above ground, the extent of the basement ceiling modification can usually be reduced to 12' x 12'. Note, however, that vertical side walls may be required if the basement wall exposure exceeds two feet.

Adding bricks or blocks to the basement ceiling can also create shelter in certain portions of the basements of split-level houses. It is recommended that expert advice be sought for basement situations which do not fit the plan sizes or illustrations in this pamphlet.

The MATERIALS LIST shows quantities for the two plan sizes shown. If additional materials are required for the building of shielding walls in an emergency, they must be added to the list.

MATERIALS LIST Item	Actual Number Required For 12' x 16' Size	Actual Number Required For 12' x 12' Size
Masonry :		
4" x 8" x 16" solid concrete blocks or 2-1/4" x 4" x 8" bricks	432 blocks or 2492 bricks	330 blocks or 1978 bricks
8" x 8" x 8" solid concrete blocks (standard stone aggregate no-sand forming)	10	10
Mortar:		
prepared dry-mix bags	1 bag	
Plywood sheets: (cut to fit exact basement dimensions)		
1/2" 5-ply Utility B-C grade, good one side.		
2'-0" x 8'-0" sections	12	6
2'-0" x 4'-0" sections		6
Steel:		
8WF17 Beam (Determine length from basement dimensions). Maximum span 16'-0" *	1	
Adjustable steel posts with tubes 13 ga., top tube 2-1/2", bottom tube 2-3/4" with 5" x 6" x 1/4" plate welded to each end.	1	
8" x 8" x 3/8" extra base plate, 4-7/16" holes in each plate.	1	
Hardware :		
3/8" x 3" sq. head unfinished bolts each with 2 washers and nuts	4	4
3/8" x 6" sq. head unfinished bolts each with 1 washer and nuts	4	4
3/8" size multiple-expanding machine bolt anchors hole size is 3/4" x 2-7/8"		
Corrugated brick ties, galvanized steel 23 ga., 7/8" x 7"	16	16
#5 screw gage size lead insert shields, hole size 1/4" x 1-1/2"	16	16
#5 x 1-1/2" unfinished wood screws	16	16
#8 x 2" cad. plated wood screws, c. s.	260	195

Special tools :

1/4" and 3/4" star drills to install anchoring devices

*Greater depth required for longer spans

CONSTRUCTION SEQUENCE

1. Drill holes in block wall for lead insert shields and attach corrugated ties with screws, two per mortar joint.
2. Lay up 8" x 8" masonry pier against wall, tying pier to wall with corrugated ties.
3. Locate and drill for machine bolt anchors in basement floor using base plate of jack post for template.
4. Thoroughly coat under side of foundation plate with rust-inhibiting paint.
5. Place foundation plate and base plate of jack post over anchors and drive anchor bolts tight.
6. Lower jack and bolt one end of steel beam to top plate, resting other end temporarily on top of pier.
7. Raise jack to level position of beam, shimming under pier end to a snug fit under the joists.

   PRECAUTIONARY NOTE: Excessive tightening of the jack post at this point may cause undue stress in the joists and slab, as the ceiling spaces are filled. Make several adjustments in the post as the material is added.

8. Grout mortar under beam at pier.
9. Cut plywood into 2 ' x 8' sheets.
10. Starting at wall, attach plywood to joist bottoms, using 2" #8 screws.
11. Remove cross bridging, if any, from existing joist spaces.
12. Fill the joist spaces with blocks or bricks.
13. Repeat steps 10, 11 and 12 for each of the other sheets.

Before constructing the shelter described here, you should check to see that the construction conforms to your local building codes, and whether a building permit is required.

If work is to be done by a builder or contractor, it is recommended that firms be retained that carry necessary insumnce and guarantees to properly protect the owner against subsequent liability and claims on the work and to ensure satisfactory results. Members of the National Association of Home Builders and the Associated General Contractors meet these and other requirements of protection for the home owner.

U.S. GOVERNMENT PRINTING OFFICE : 1982 0 - 376-178

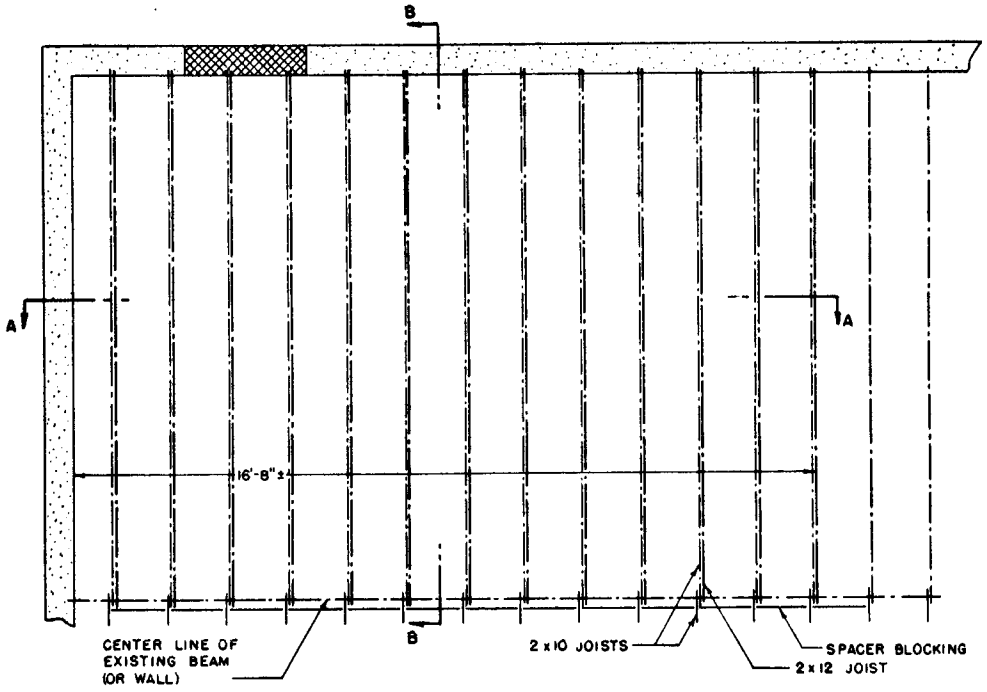
B

H-12-B
May 1980

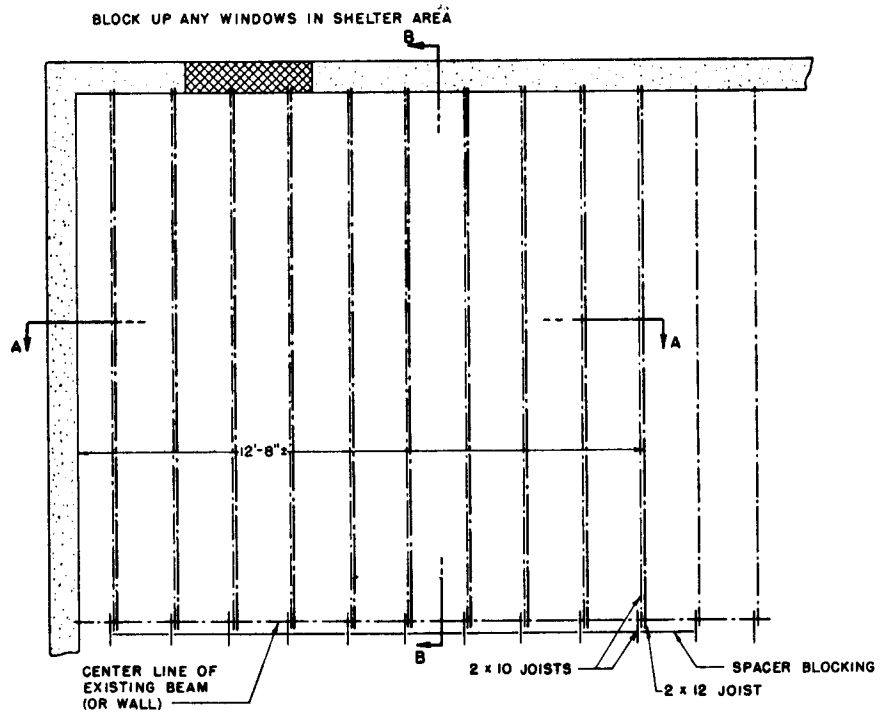
Protection is provided
in a basement corner
by bricks
or concrete blocks
between the overhead joists.
Additional 2" x 12" joists
support
the extra weight.

HOME FALLOUT SHELTER
modified ceiling shelter–basement location plan b

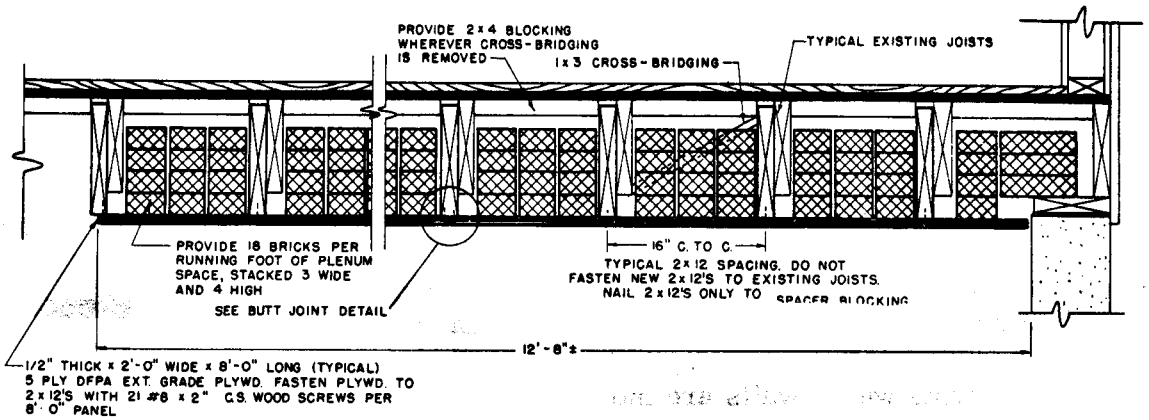
FEDERAL EMERGENCY
MANAGEMENT AGENCY



PLAN FOR 12' x 16' SHELTER



PLAN FOR 12' x 12' SHELTER



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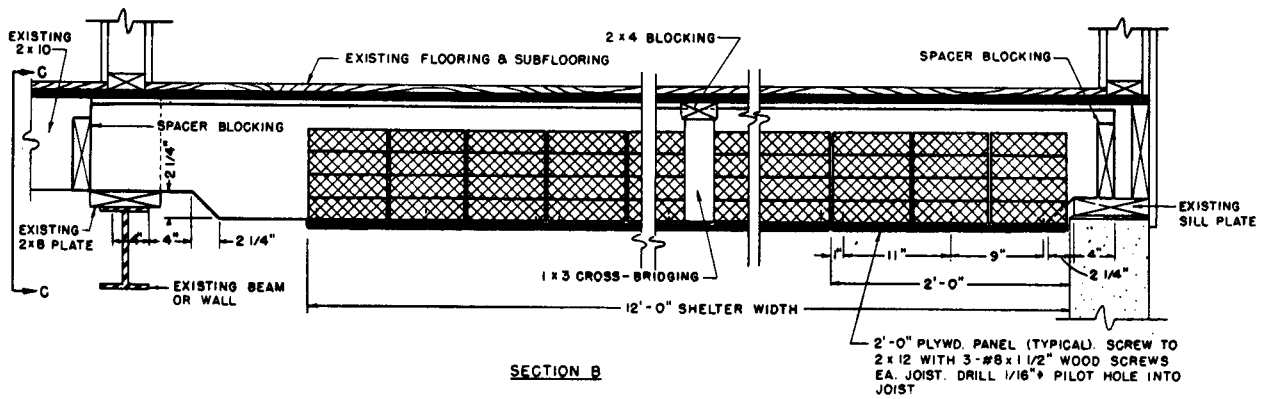

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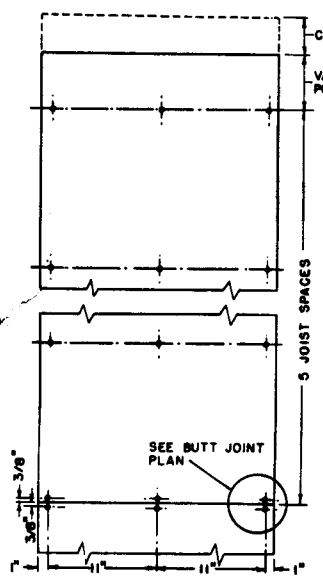
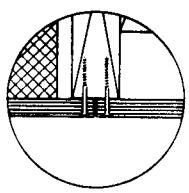
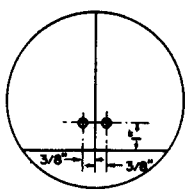


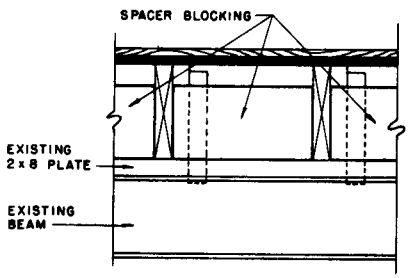
PLAN OF TYPICAL PLYWOOD CEILING PANEL



BUTT JOINT DETAIL



BUTT JOINT PLAN



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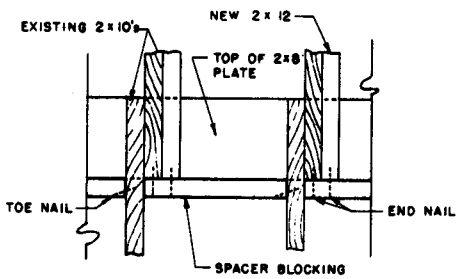


PLAN DETAIL OF SPACER BLOCKING

GENERAL INFORMATION

This shelter can be permanently installed in the basement of your home and will not interfere with its utility in any way.

In basements whose walls are mostly below grade on all four sides, adequate shelter from fallout radiation is provided by modifying the overhead 2 x 10 floor joist and ceiling construction as shown in the drawings. New 2 x 12 joists, notched to the depth of the existing 2 x 10s, are installed alongside these joists in order to carry the extra weight of the shielding material. Plywood, screwed to the 2 x 12 bottoms, supports the masonry and provides a solid base for a more decorative ceiling treatment.

Approximately 2 man days are required to construct the ceiling.

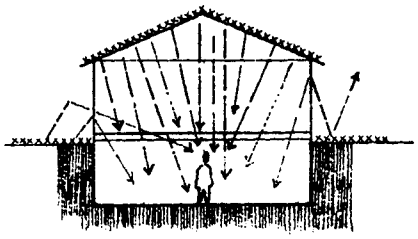
SHELTER SIZE

The plans on the preceding pages show two sizes of shelters of this type - a 12' x 16' size, which may be suitable for use in many one story homes, and a 12' x 12' size, which is suitable for use in many two story homes.

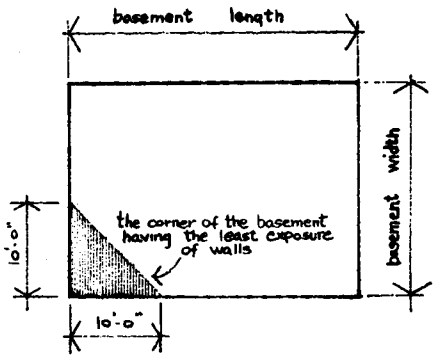
On the following pages, under LIMITATIONS OF THE CEILING MODIFICATION SHELTER IN BASEMENTS, you will find illustrations of the conditions which make this type of construction an effective shelter, and some additional things that must be done if these conditions are not met by your particular basement situation.

Note that if some joist spaces contain heating ducts, or are closed in with sheet metal to serve as return air ducts, the protection in this area of the shelter is reduced since bricks or blocks cannot be placed as shown in the drawings.

LIMITATIONS OF THE CEILING MODIFICATION SHELTER IN BASEMENTS

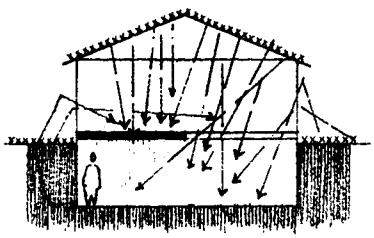


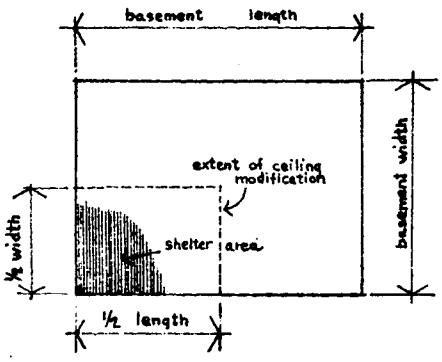
This cross-section of a one story house shows radiation coming into the basement from fallout particles on the roof and the ground. Most of the radiation comes from the roof because of the shielding effect of the ground outside the basement walls.



The shaded area in the basement floor plan shows the location of the best potential shelter area (approximately 50 square feet). The drawings on the preceding pages are for the adding of bricks or blocks in the ceiling over this best corner.

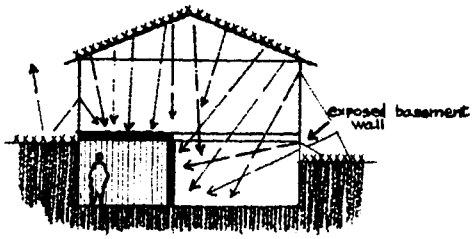
This placement of added weight in the proper portion of the basement ceiling will considerably improve the protection in the best corner. Note that is not necessary to add this weight to the entire ceiling area.

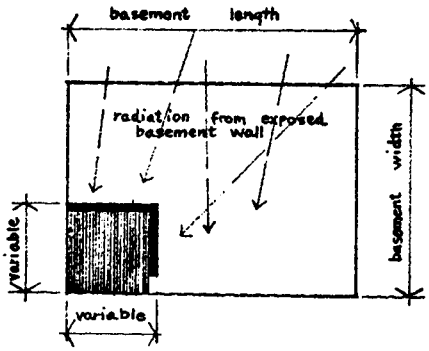




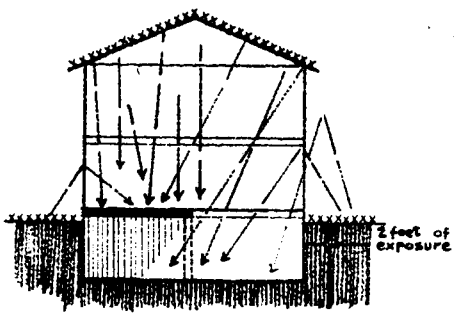
The extent of the ceiling modification area depends on the type of house (i.e., one or two story), the dimensions of the basement, and the amount of basement wall exposure. In a one story house, approximately one - quarter of the area of the basement ceiling should be filled with the concrete blocks or bricks in order to obtain the most protection out of this improvement.

This arrangement will effectively shield all of the radiation coming from the roof - the largest contributing source.





If it is found to be impractical to shield one quarter of the basement ceiling area, the extent of ceiling modification may be reduced to any desired size by constructing vertical masonry walls on the two open sides of the shielded area, thus providing a room suitable for use as a hobby or laundry room. These masonry walls will also provide protection from excessive amounts of radiation coming through exposed portions of the basement wall.



In homes with 2 or more stories above ground, the extent of the basement ceiling modification can usually be reduced to 12' x 12'. Note, however, that vertical side walls may be required if the basement wall exposure exceeds two feet.

Adding bricks or blocks to the basement ceiling can also create shelter in certain portions of the basements of split-level houses. It is recommended that expert advice be sought for basement situations which do not fit the plan sizes or illustrations in this pamphlet.

The MATERIALS LIST shows quantities for the two plan sizes shown. If additional materials are required for the building of shielding walls in an emergency, they must be added to the list.

MATERIALS LIST

Item	Actual Number Required For 12' x 16' Size	Actual Number Required For 12' x 12' Size
Masonry:		
2-1/4" x 4" x 8" solid bricks	2592	1944
Lumber ("Construction" or "No. 1" grades or better):		
New joists 2 x 12 cut to fit existing span	14	11
Blocking 2 x 8 x 1'-0-3/4"*	24	18
2 x 4 x 1'-0-3/4"*	12	9
Plywood sheets		
1/2" 5-ply, Utility B-C grade, good one side		
2'-0" x 8'-0" sections	12	6
2'-0" x 4'-0" sections		6
Hardware:		
#8 x 2" cad. plated wood screws	288	216
16d common nails	3 lbs.	3 lbs.

*Cut to fit exact joist spacing

CONSTRUCTION SEQUENCE

1. Cut 2 x 12s to length required for bearing at both ends (see drawing).
2. Cut end notches in 2 x 12s as shown on drawings. Be sure to ease the notch at 45° or less angle as shown. Be careful not to saw further than 2" notch depth required.
3. Starting at the wall, remove the cross bridging from 6 joist spaces and insert the 2 x 12s into the spaces over the center beam or wall, shaving the joist as far as is needed to allow raising the end at the outside wall for seating on the plate.
4. Measure the width of the spaces left and cut the center and end blocking.
5. Install the center and end blocking, nailing as shown in the details.
6. Reinstall one (shortened) piece of cross-bridging under the center blocking.
7. Starting at the wall, attach one 1/2" plywood panel to the 2 x 12s, using the two inch #8 screws as shown in the plan.
8. Fill the joist spaces above the plywood with bricks or a combination of blocks and bricks to provide as much weight as possible in the depth of the 2 x 12s, which is the intention of the drawings.
9. Repeat steps 7 and 8 for the entire width of the shelter.
10. Repeat steps 3 through 9 for the balance of the length of the shelter.

Before constructing the shelter described here, you should check to see that the construction conforms to your local building codes, and whether a building permit is required.

If work is to be done by a builder or contractor, it is recommended that firms be retained that carry necessary insurance and guarantees to properly protect the owner against subsequent liability and claims on the work and to ensure satisfactory results. Members of the National Association of Home Builders and the Associated General Contractors meet these and other requirements of protection for the home owner.

U.S. GOVERNMENT PRINTING OFFICE : 1982 0 - 376-179

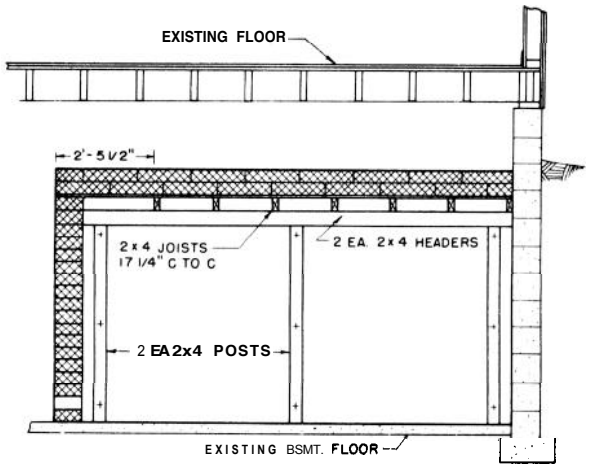
C

H-I 2-C
May 1980

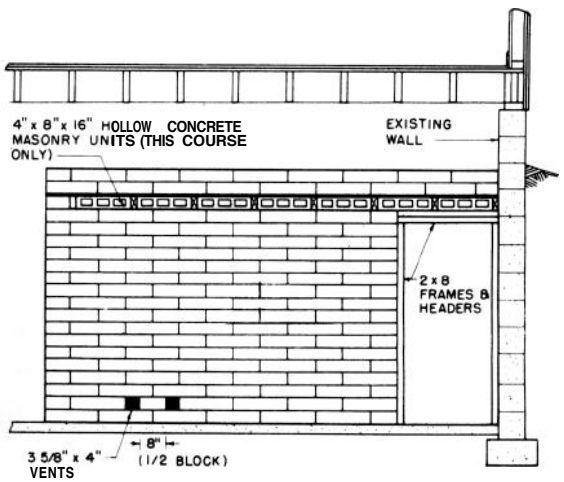
A compact shelter
is provided
in a basement corner
by the use of
common lumber
and concrete blocks
with mortar joints
for permanent construction.

HOME FALLOUT SHELTER
concrete block shelter-basement location plan C

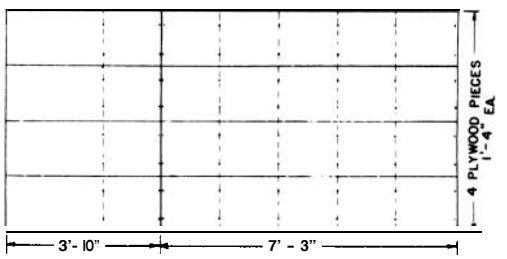
FEDERAL EMERGENCY
MANAGEMENT AGENCY



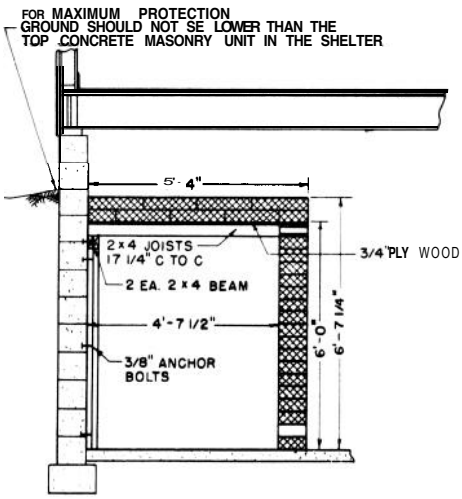
SECTION A



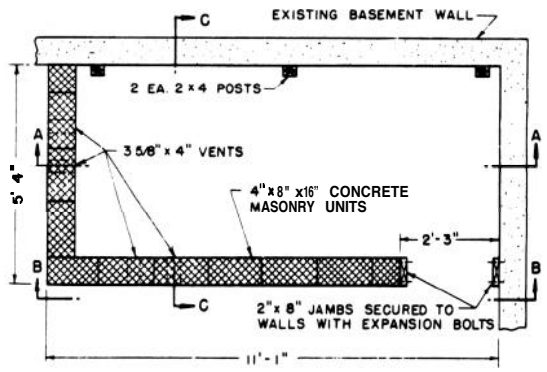
SECTION B



PLAN OF PLYWOOD CEILING



SECTION C



PLAN

GENERAL INFORMATION

This compact basement shelter will provide low-cost protection from the effects of radioactive fallout. Its purpose is to provide adequate protection for the minimum cost in an existing basement. In addition to the low cost, materials should be readily available, and the labor time will be short.

TECHNICAL SUMMARY

This shelter has about 50 square feet of area, 300 cubic feet of space and will provide shelter for five persons.

The materials required to build this shelter are obtainable at local concrete block plants and/or lumber yards.

Natural ventilation is provided by the entranceway and the air vents in the shelter wall.

Estimated construction time for the basic shelter is less than 44 man-hours.

MATERIALS LIST

Item	Actual Number Required
Masonry:	
4" x 8" x 16" solid concrete masonry units or	296 blocks
2-1/4 x 4" x 8" solid bricks	1776 bricks
4" x 8" x 16" hollow concrete masonry units	7 blocks
Lumber: ("Construction" or "No. 1" grade or better)	
posts 2 x 4 x 5'-4"	6
joists 2 x 4 x 5'-4"	7
beams 2 x 4 x 10'-5-1/2"	2
frame 2 x 8 x 5'-4-3/8"	2
header 2 x 8 x 2'-3"	2
plywood 1'-4" x 6'-9-1/4" x 3/4" (utility B-C grade)	4 pieces
plywood 1'4" x 4'-3-3/4" x 3/4" (utility B-C grade)	4 pieces
Hardware :	
8d nails	2 pounds
10d nails	2 pounds
3/8" bolt size multiple-expanding machine bolt anchors	18
3/8" x 3-1/2" square-head unfinished anchor bolts	18
Mortar (prepared dry-mix bags	9 bags

Special tools :

3/4" star drill for 3/4" x 2-7/8" anchor bolts

CONSTRUCTION SEQUENCE

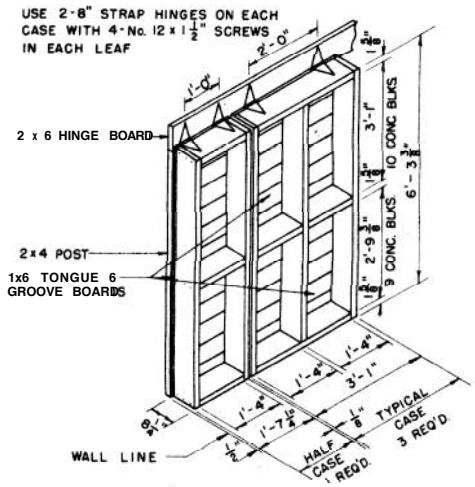
1. Lay out guidelines with chalk on basement floor for shelter walls.
2. Lay first course of 4" x 8" x 16" solid blocks in a full bed of mortar to make the walls 8" thick. Vary the thickness of mortar bed if basement floor is not level.
3. Set door frame in place and continue to lay wall blocks. Be sure to leave the 4 " spaces for air vents as shown on the drawing.
4. Continue this procedure until the walls have been laid up to a height of 5'-8" (17 courses). This height can be increased, if the basement headroom permits and provided the shelter roof remains below the outside ground level.
5. Fasten posts and door frame to the basement wall using two expansion anchors and bolts for each. Be certain the posts rest on the floor.
6. Nail two 2 x 4 boards together to make the wall beam. Nail the beam on top of the posts and secure with expansion anchors and bolts to the wall.
7. Place wood joists in position and secure with nails.
8. Place the 4" x 8" x 16" hollow blocks between joists as shown on the drawing. The holes in the blocks will afford ventilation.
9. Put several 3/4" pieces of plywood on the joists as shown and nail them to the joists with 8d nails.
10. Lay two layers of solid 4" x 8" x blocks flat on top of the plywood; stagger the joints. Mortar is not required in the ceiling.
11. Continue procedures 9 and 10 until the roof is completed.
12. Additional blocks stored in the shelter are for stacking in the entryway after occupancy.

H-12-E
April 1980

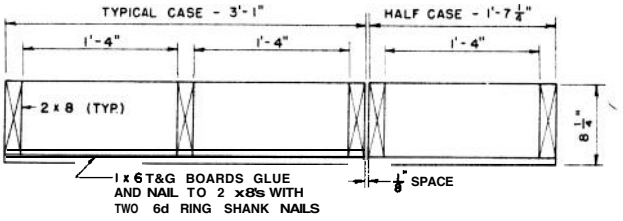
A storage unit is hinged to the wall in a basement corner. It is tilted-up to rest on stacked brick or concrete block and filled for overhead protection.

HOME FALLOUT SHELTER
tilt-up storage unit shelter-basement **location**

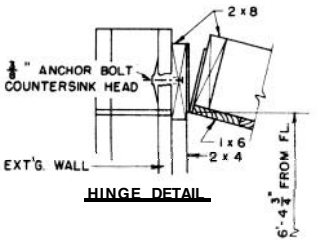
FEDERAL EMERGENCY
MANAGEMENT AGENCY



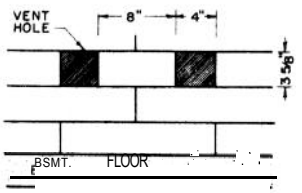
ISOMETRIC OF CASES



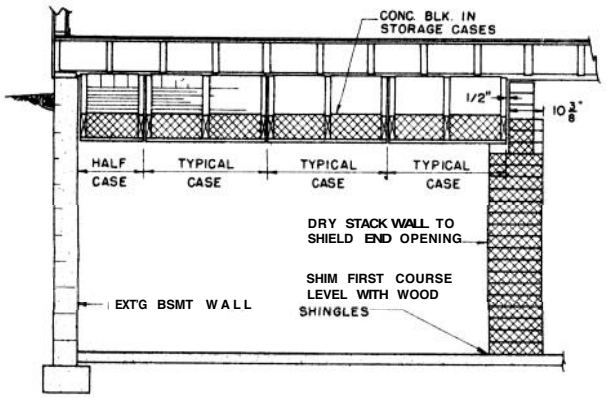
DETAIL SECTIONS



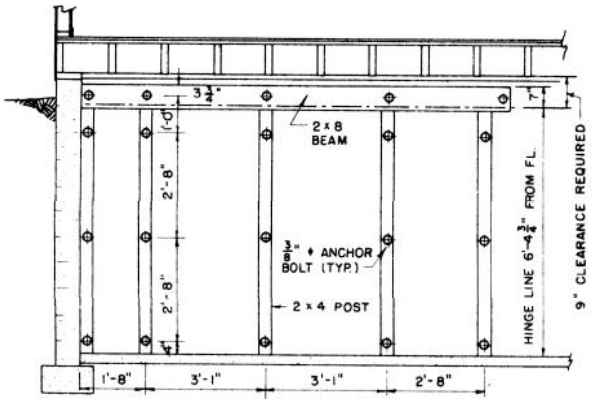
HINGE DETAIL



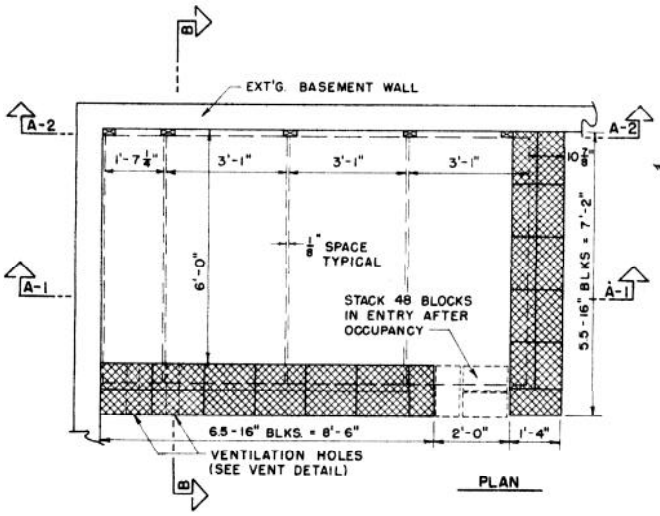
AIR VENT DETAIL



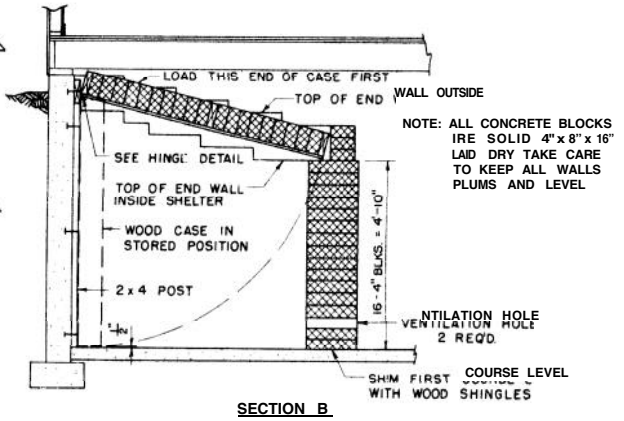
SECTION A-I



SECTION A-Z



PLAN



NOTE: ALL CONCRETE BLOCKS IRE SOLID 4" x 8" x 16" LAID DRY TAKE CARE TO KEEP ALL WALLS PLUMS AND LEVEL

SECTION B

GENERAL INFORMATION

The principal feature of this shelter is a roof composed of tilt-up storage units, the top of which is hinged to the wall. The units can be used as book cases, pantry shelves, or for miscellaneous storage. In an emergency, the storage units can be tilted up so that they rest on a stacked masonry wall built from materials stored nearby the units.

In basements where the outside ground level is above the top of the tilted-up units, adequate shelter from fallout radiation is provided by filling the units with brick or solid concrete block 8" thick. The shelter will house 6 people.

Approximately 2 man days are required to construct the storage units. The materials are readily available, from retail lumber yards.

MATERIALS LIST

Item	Actual Number Reauired
Masonry:	
4" x 8" x 16" solid concrete masonry units or	575 blocks or
2-1/4" x 4" x 8" solid bricks	3450 bricks
Lumber: ("Construction" or "No. 1" grades or better)	
posts 2 x 4 x 6'-4-1/4"	5 pieces
beam 2 x 8 x 10'-11-5/8"	1 piece
3 cases plus half case	
2 x 8 x 6'-3-3/8"	8 pieces
2 x 8 x 6'-O-1/8"	3 pieces
2 x 8 x 1'-4"	9 pieces
2 x 8 x 2'-9-5/8"	6 pieces
1 x 6 x 1'-7-1/4" T & G*	13 pieces
1 x 6 x 3'-1" T & G *	39 pieces
Hardware :	
3" x 8" x 1/8" unfinished steel strap hinges	8
#12 x 1-1/2" wood screws, c. s.	64
3/8" diam. x 6" square head unfinished anchor bolts	20
3/8" bolt size multiple-expanding machine bolt anchor	20
6d ring shanked nails	3 pounds
glue, protein emulsion (must develop 450 lbs. /sq. in.)	1-1/2 pints
16d common nails	3 pounds

*Square edge boards may be used.

Special tools :

bubble level to insure wall is level as it is stacked

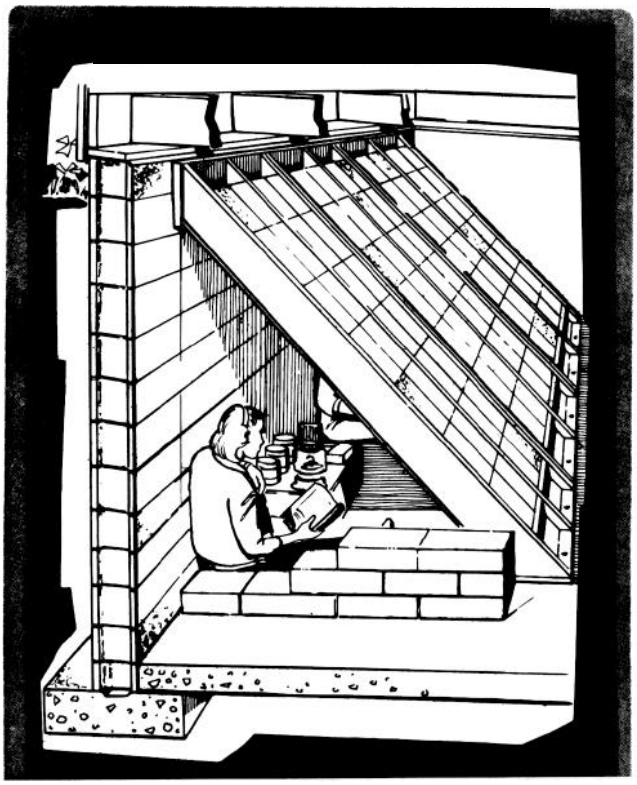
3/4" star drill for making anchor holes in existing basement wall

CONSTRUCTION SEQUENCE

1. Prepare wood case units.
   a. Assemble wood units in accordance with drawings on sheet 2.
   b. Fasten hinges to hinge board with 1-1/2" #12 * wood screws.
   c. Locate and drill holes in basement walls to receive machine bolt anchors.
   d. Bolt hinge board and 2 x 4 posts to wall with 3/8" anchor bolts.
   e. Fasten wood case units to hinges with 1-1/2" #12* wood screws.
2. Provide suitable storage location for required concrete block.
3. Assembly of shelter.
   a. Remove items stored from wood case units.
   b. Mark location of shelter walls on floor with chalk.
   c. Move concrete blocks lo shelter location.
   d. Lay first course of blocks for shelter walls, shimming block as required with wood shingles until course is level. It is important that the wall be stacked as nearly level and plumb as possible for stability.
   e. Tilt up case units in corner of basement and support temporarily with 2 x 4 prop or household step ladder. Build-up 16" concrete block wall to support case units.
   f. Remove prop, lower case units to block wall and fill case units with concrete blocks.
   g. Build end wall up above the side of the end storage unit.
   h. Move 48 concrete blocks into shelter.
   i. Occupy shelter and fill entry with 48 blocks.

* Drill lead holes 5/32" in diameter, 1-3/8" deep and shank lead holes 3/16" in diameter, 3/8" deep.

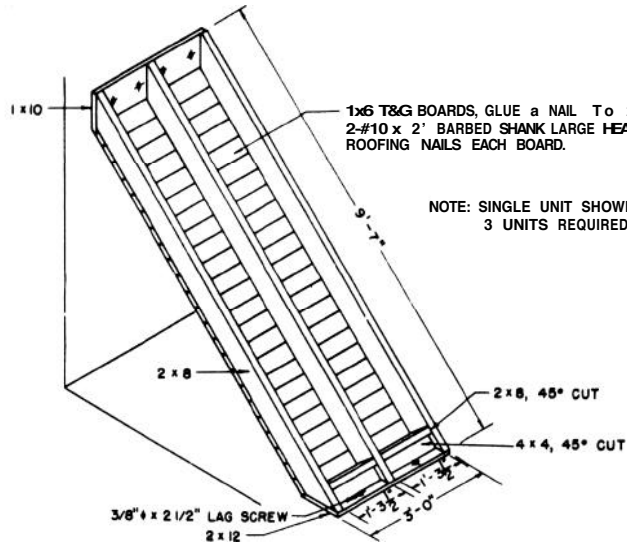
H-I 2-F
April 1980



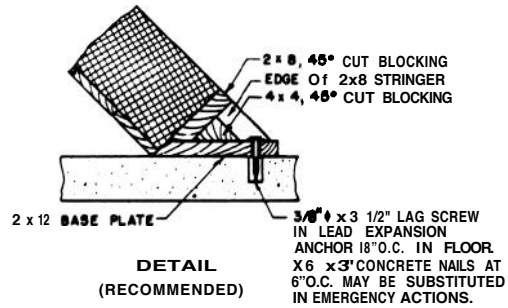
Pre-built wood components
stored
in the basement
may be
assembled
and filled
with bricks
or concrete blocks
for emergency protection.

HOME FALLOUT SHELTER
lean-to shelter-basement location plan f

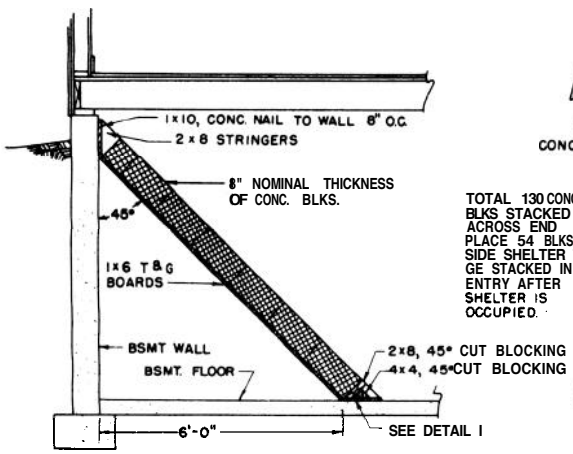
FEDERAL EMERGENCY
MANAGEMENT AGENCY



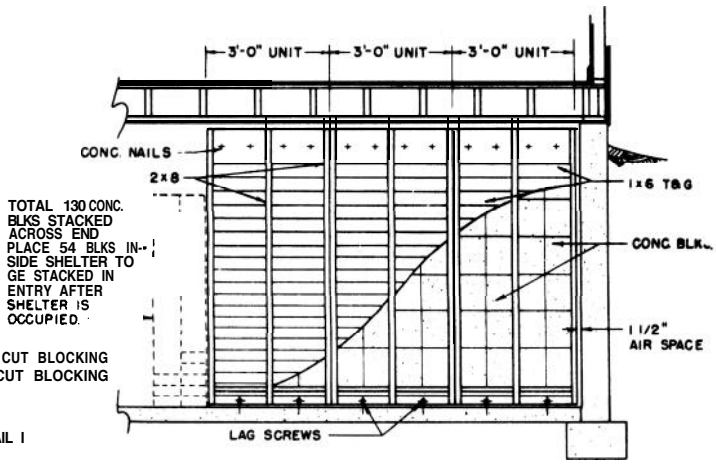
ISOMETRIC OF LEAN-TO UNIT



DETAIL
(RECOMMENDED)

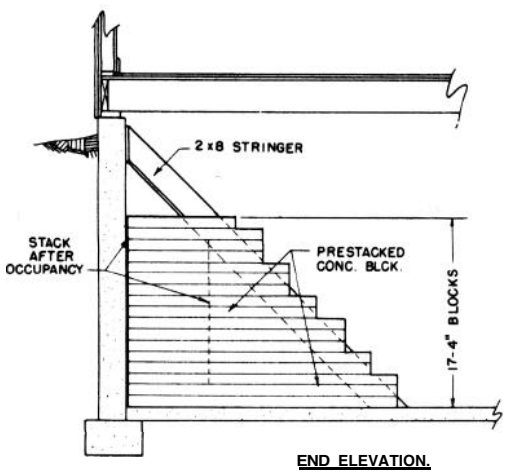


SECTION A

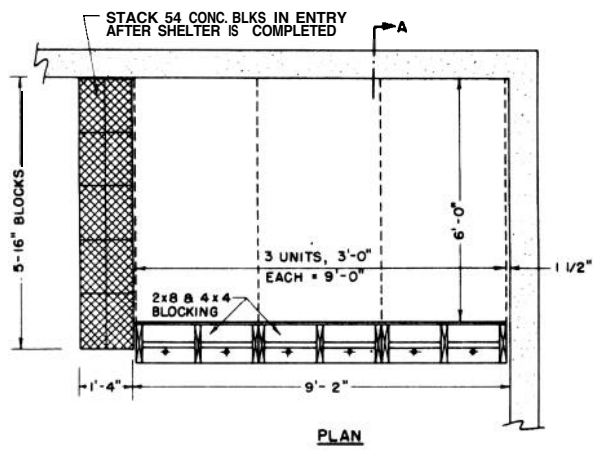


TOTAL 130 CONC. BLKS STACKED ACROSS END PLACE 54 BLKS IN-SIDE SHELTER TO GE STACKED IN ENTRY AFTER SHELTER IS OCCUPIED.

FRONT ELEVATION



END ELEVATION.



PLAN

GENERAL INFORMATION

This shelter is designed to provide protection from the effects of radioactive fallout in the below grade basement of an existing house. Its advantages are low cost, simplicity of construction, general availability of materials, and the fact that it may be easily disassembled.

TECHNICAL SUMMARY

This shelter design will provide 54 square feet of area and approximately 216 cubic feet of space. It will house three persons. The shelter length can be increased by increments of 3 foot panels. The height may be increased by the use of more materials. This increase will be limited by basement height and handling of the panels.

The materials necessary to construct this shelter should be available from retail lumber yards.

Natural ventilation is obtained by omitting 3 blocks from the top of the entranceway closure and by leaving a 1-1/2 in. gap between the end of the shelter and the basement wall.

Construction time should not exceed 20 man-hours when all the materials are on hand at the shelter location. It is desirable to preassemble the lean-to units and store them in a corner. They can then be installed in the best corner of the basement and stacked with blocks in 1 hour.

MATERIALS LIST

Item	Actual Number Required
Masonry :	
4" x 8" x 16" solid concrete masonry units or	290 blocks or
2-1/4" x 4" x 8" solid bricks	1740 bricks
Lumber: ("construction" or "No. 1" grades or better)	
stringers 2 x 8 x 9'-7" (45" diag. cut at both ends)	9 pieces
boards 1 x 6 x 3'-0" T & G (square edge may be used)	69 pieces
1 x 10 x 3'-0"	1 piece
2 x 10 x 3'-0"	1 piece
blocking 2 x 8 x 1'-3-1/2 stress-grade lumber	6 pieces
4 x 4 x 1'-3-1/2"	3 pieces*

*Rip lengthwise at 45" to provide the 6 pieces required

Hardware:

3/8" diam. x 2-l/4" lag screws and washers	12
3/8" bolt size lead expansion shield, 9/16" x 2" hole	12
#lO ga. x 2" barbed shank, large head roofing nails	3 pounds
16D common nails	1 pound
glue, protein emulsion (must develop 450 lbs. /sq. in.)	1-1/2 pints
#5 x 3" concrete nails	36

Special tools :

9/16" star drill to install anchor bolts into concrete basement floor and walls

CONSTRUCTION SEQUENCE

1. Prepare shelter units.
   a. Cut 45° bevels on 2 x 8 stringers. Arrange in 3 foot panels. Using 16d common nails, attach bottom boards and blocking on the beveled ends first,
   b. Fit in, glue and nail remaining bottom boards with large head roofing nails.
   c. Units can be stored assembled, if desired, to save time. It is desirable to locate lag screw holes and install lead shields in floor and basement wall.

2. Assemble shelter (emergency actions)
   a. Turn this panel right side up and place it in its permanent position. Fasten the panel to the floor with lag screws in lead shields leaving a 1-1/2" gap between the end of the shelter and the basement wall. If lead shields have not been installed ahead of time, use concrete nails as shown in the detail.
   b. Fasten in sequence as many panels as are to be used. Nail to wall with concrete nails.
   c. Fill panels with 2 layers of solid concrete block or brick starting at bottom.
   d. Build end wall of 76 stacked blocks 456 bricks.
   e. Place 50 blocks or 300 bricks in the shelter for emergency closure of entranceway.